

APPENDIX M:

Risk Assessment (East End of Courtyard)

APPENDIX M

UPDATED RISK ASSESSMENT (EAST PORTION OF COURTYARD) **(Based on conditions on October 2016)**

Note: This risk assessment is conducted for the east portion of the courtyard where petroleum contamination is located, mostly at depths below the shallower PCB, metal, pesticide and asbestos contamination; and is based on current conditions, following the excavation of the 0-1 foot interval soils and partial excavation of the 1-3 foot interval soils. Supplemental field investigation was conducted during September 2016 to determine the horizontal and vertical extent of petroleum contamination, and to provide updated information on PCB levels in soils following excavation. This risk assessment was conducted following the same procedures as the original risk assessment (documented in Appendix C).

Asbestos is present in shallow soils. This risk assessment does not address the risks associated with asbestos exposure. An assumption is made that all asbestos-contaminated soils will be excavated and either transported off-site for appropriate disposal or placed in an on-Site soil repository.

Unique elements to this risk assessment are provided below.

Exposure Point, Soil Intervals for Exposure Point, Receptors and Human Exposure Profiles

The exposure point is the east side of courtyard in the vicinity of the FO-1 fuel oil bunker. The exposure point extends from the east side of the smoke stack eastward to the retaining wall bordering the Concord River, and from the Picker Building north to the Boiler House. Soil intervals for this risk assessment are based on current grade, following the excavation of 0-1 feet of soils west of the FO-1 fuel oil bunker and 0-2.5 feet of soils over, north, south and east of the FO-1 fuel oil bunker. The soil intervals are 0-3 foot interval, 3-6 foot interval and 6-20 foot interval. The 6-20 foot soil interval is deeper than typical for a risk assessment conducted under the Massachusetts Contingency Plan (MCP); however, the higher levels of petroleum contamination are present more than 15 feet below current grade and is included only to give context to the contamination present at depth.

The receptors are the same as for the original risk assessment (i.e., residents and construction workers). The exposure profiles for the receptors are the same as specified in the original risk

assessment, provided in Appendix C, with one exception. For the resident, direct contact and incidental ingestion exposure is presumed limited to three days a week during the six-month construction project.

Identification of Contaminants of Concern

The representative analytical data for the eastern portion of the courtyard were evaluated to identify soil contaminants of concern for the risk assessment, as documented in Table D-1. Specific oils or hazardous materials (OHM) were eliminated as contaminants of concern because: (1) they were not detected in any of the representative soil samples; or (2) they were always detected in the representative soil samples at levels less than MassDEP's published background concentrations for soils associated with fill containing coal ash or wood ash (i.e., arsenic, cadmium, chromium, lead, nickel and zinc). Acenaphthylene was always detected at a level less than its background concentration; however, it was retained as a contaminant of concern, because all other polycyclic aromatic hydrocarbons (PAHs) were detected at levels exceeding their background concentrations.

Soil contaminants of concerns include the following: (1) each extractable petroleum hydrocarbon (EPH) subset; (2) seventeen PAHs; (3) one volatile petroleum hydrocarbon (VPH) subset – C9-C10 aromatic hydrocarbons; (4) two aromatic volatile organic compounds (VOCs) – benzene and toluene; (5) two pesticides – chlordane and dieldrin; (6) three metals – barium, mercury and vanadium; and (7) PCBs.

As documented in Table 6.1 to 6.4 of this IRA Plan Modification No. 3, four soil samples were collected for analysis of PCB congeners. One soil sample contained a low concentration of total congener PCBs (0.025 mg/kg) and was eliminated from complete evaluation. USEPA's document, Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) & Dioxin-Like Compounds (EPA/100/R 10/005/ December 2010), identifies twelve TCDD dioxin-like PCB congeners. Of these twelve TCDD dioxin-like congeners, eight were detected in the soil samples (Appendix C Table C-7). Combined, these eight TCDD dioxin-like PCB congeners comprise between 9.9 and 11% of the total PCB congeners (Appendix C Table C-9). The eight TCDD dioxin-like PCBs were retained as separate soil contaminants of concern.

The soil contaminants of concern are also the dust contaminants of concern.

Derivation of Exposure Point Concentrations

The representative analytical data for the 0-3, 3-6 and 6-11 foot intervals were evaluated in Tables D-2, D-3 and D-4, respectively, to determine the appropriate method to derive exposure point concentrations. For all contaminants of concern, except PCBs (and its dioxin-like congeners), the

appropriate exposure point concentrations are the mean concentrations. For PCBs, for the 0-3 and 3-6 foot intervals, more than 25% of the data exceeded the Method 1 S-2 Direct Contact standard for PCBs. Therefore, for PCBs, the 95th % Upper Confidence Limit on the mean is identified as the appropriate exposure point concentration for the 0-3 and 3-6 foot intervals. The 95th % Upper Confidence Limit on the mean was also selected as the appropriate exposure point concentration for PCBs in the 6-11 foot interval soils, to be consistent with required method under the federal Toxic Substances Control Act.

The exposure point concentrations for the 0-3, 3-6 and 6-11 foot intervals are calculated in Tables D-5, D-6 and D-7, respectively. Whenever, a contaminant of concern was not detected in a specific sample, one-half the sample detection limit was used when calculating the exposure point concentration.

Exposure point concentrations were calculated for TCDD dioxin-like PCB congeners, for input in the risk assessment as TCDD dioxin. The TCDD dioxin exposure point concentrations were calculated considering: (1) the exposure point concentrations for PCBs; (2) the portion of PCBs comprised of TCDD dioxin-like congeners (11%); and (3) the Toxicity Equivalence Factors (which was the same (3E-05) for all TCDD dioxin-like congeners detected at the Site), as documented in Appendix C Tables C-7 to C-9 and Appendix D Table D-8. Note: Percent TCDD dioxin-like congener composition of PCBs was based on the congener PCB data. However, because congener PCB data was not available for most soil samples, the Aroclor PCB data was used to derive the TCDD dioxin-like PCB exposure point concentrations.

In addition, dust exposure point concentrations were estimated following the same procedure as in Appendix C. The exposure point concentrations are calculated and documented in Appendix D-4 Tables 1.1 and 1.2.

Identification of Groundwater and Soil Categories

The soil and groundwater categories are the same as identified in the original risk assessment, provided in Appendix C.

Media	Category	Location, Depth Interval and Comment
Groundwater	GW-3	Entire aquifer beneath the courtyard
Courtyard Soils	S-2	Presumed Current and Future Residential Conditions: All Soil Volumes (All soils covered with a protective barrier)
	S-3	Presumed Current and Future Commercial Conditions: All Soil Volumes (All soils covered with a protective barrier)
	S-3	Construction / Utility Work: All Soil Volumes (All soils covered with a protective barrier), except during construction / utility work

Note: The lowest soil category applicable to a soil volume, after considering all receptors and current and foreseeable uses, is provided. An assumption is made that gardening of edible produce will not occur in the future in the soils of the courtyard, except under Best Management Practices. For the courtyard, an assumption is made that future use will include multi-family residential, child school, daycare, institution, playground, active recreational, commercial, industrial or passive recreational use, but will not include single-family residences. In addition, for the exterior courtyard, all soils are presumed covered by protective barriers, except during short-term construction or utility work, which will be conducted under Site-specific Soil Management Plan. These assumptions require the implementation of a Notice of Activity and Use Limitation (AUL).

Characterization of Risk of Harm to Human Health

The characterization of risk of harm to human health was calculated in the same was in the original risk assessment, provided in Appendix C. For this risk assessment, the construction worker risk assessments are provided in Appendices D-1 to D-3, and the resident risk assessments are provided in Appendix D-4. Dose-response values, exposure point concentrations and receptor exposure calculations are also provided in these same appendices.

Results of Human Health Risk Characterization

Risk of Subchronic and Chronic Threshold (Non-Carcinogenic) Health Effects: For each receptor group, the total cumulative subchronic or chronic HI is compared to MassDEP's cumulative non-cancer risk limit of 1.0. Subchronic HI were calculated for resident and construction worker. Limits on future exposure to residents, entailing the maintenance of a protective barrier over soils were assumed. No chronic HI were calculated, because no chronic exposure exists under current and presumed conditions. The results of the non-cancer risk assessments are summarized in Appendices D-1 to D-3 for construction workers and Appendix D-4 for residents. The cumulative HIs are compared to the non-cancer risk limit in Table D-9.

Based on these findings, No Significant non-cancer Risk of harm exists for the 0-3, 3-6 and 3-11 foot interval courtyard soils for both receptors, presuming that a protective barrier is maintained over the soils of the courtyard. For the 0-3 and 3-6 foot interval soils, No Significant Risk of harm exists for residents; however, an additional assumption is made that the frequency of exposure to these soils would be limited during a construction project, through the implementation of specific provisions in a Soil Management Plan. The principal contributors of the non-cancer risk estimates are PCBs and dioxin (TCDD equivalence).

Risk of Non-Threshold (Carcinogenic) Health Effects: For each receptor group, the total cumulative ELCR is compared to MassDEP's cumulative cancer risk limit of 1E-05. ELCRs were calculated for resident, commercial worker and construction worker. Limits on future exposure to residents, entailing the maintenance of a protective barrier over soils and implementation of a soil

management plan during future construction or utility work, were assumed. The results of the cancer risk assessments are summarized in Appendices D-1 to C-3 for construction workers and in Appendix D-4 for residents. A comparison of the cumulative ELCRs to the cancer risk limit is provided in Table D-9.

Based on these findings, No Significant cancer Risk of harm exists for construction workers for all soil intervals, and exists for residents for all soil intervals. The principal contributor to the cancer risk estimate is PCBs, followed by dioxin (TCDD equivalence), specific PAHs and dieldrin.

Comparison of Site Conditions to Applicable or Suitably Analogous Public Health Standards: No applicable or suitably analogous public health standards were identified for the Site.

Uncertainty Analysis

The uncertainty analysis is the same as that in the original risk assessment, provided in Appendix C.

Risk Characterization Conclusions

Conclusions Regarding Risk of Harm to Human Health and Conditions for Notice of Activity and Use Limitation

Risk of harm to human health was characterized for the east portion of the courtyard via a MCP Method 3 Human Health Risk Characterization. Assumptions limiting future activities or uses of the Site were considered during the course of the risk characterization.

The total cumulative HIs for all receptors were less than MCP's Method 3 cancer and non-cancer risk limits for the 0-3, 3-6 and 3-11 foot intervals. However, exposure was presumed limited to a six-month construction period, and, residential exposure to 0-3 and 3-6 foot interval soils was presumed limited in frequency via implementation of specific provisions in a Soil Management Plan. These specific provisions in the Soil Management Plan can be eliminated by placing the 0-3 and 3-6 foot interval soils of the eastern courtyard in an on-site isolated soil repository or by transporting the soils off-site to an appropriate facility. These risk assessment findings presume that a protective barrier is maintained over the soils of the courtyard. Gardening of edible produce is presumed not to be conducted within the disposal site boundaries through Best Management Practices.

These risk assessment findings require that a protective barrier be maintained over the soils of the courtyard, any subsurface utilities be placed in a clean utility corridor, and perhaps special provisions to reduce frequency of residential exposure during a construction project or placement of the 0-3 and 3-6 foot interval soils in a soil repository. These assumptions would require the implementation of a Notice of AUL for the courtyard in order for the findings of the risk assessment

to be valid. Requirements of the Notice of AUL would include: (1) periodic inspection and maintenance of the protective barrier over the soils; (2) inspection and maintenance of the clean utility corridor, following each utility project; (3) during construction projects, the use of a Soil Management Plan to properly manage soils (and to perhaps minimize potential residential exposure to soils); and (4) following the completion of the construction project the placement of the soils at its original depth and reinstallation or repair of the protective barrier.

The slated for remediation could be either sent to a low level (<50 mg/kg) PCB facility or could be placed in an on-Site soil repository, at a depth more than 3 feet below grade. Potential on-site soil repositories identified for the Site include a coal chute, utility vault located in the northwest corner of the courtyard, four dry wells discovered in the western portion of the courtyard, and, following excavation, the FO-1 and FO-2 vault areas in the east portion of the courtyard. These areas would have separate Notice of AUL conditions, including: (1) physical separation from surrounding soils; (2) not allowing any excavation of these soils except by persons who are 40-hour HAZWOPER trained under OSHA and under the direction of an LSP; (3) either replacement of soils back into the repository or off-site transport of the soils following excavation; and (4) maintenance of the soil repositories.

The shallow soils of the courtyard are contaminated with asbestos. Soils contaminated with asbestos are presumed to constitute a Significant Risk of harm to human health, even following short-term exposure. Therefore, the asbestos-contaminated soils should be either transported off-site to a facility authorized to receive asbestos-contaminated and low-level PCB-contaminated soils or should be placed in an on-Site soil repository. Additional provisions of the Notice of AUL for the repositories relative to the asbestos include the following: (1) not allowing excavation of these soils except by persons who are trained to work with asbestos contamination and under the oversight of a certified asbestos monitor and/or abatement contractor; and (2) the Soil Management Plan must include requirements for asbestos monitoring and decontamination procedures.

The principal risk drivers for the human health risk characterization are PCB and, to a lesser extent, dioxin (TCDD equivalence). Site-specific cleanup standards could be derived prior to beginning clean up to help in evaluating whether to place specific soil volumes in repositories or to transport the soils off-Site. However, based on GEC's experience given the complex mixture of OHM present in the soils, a quick, volume-specific risk assessment using MassDEP's ShortForm or GEC's risk assessment workbook would provide greater flexibility.

Method 3 Risk Assessment for Chemicals in Soil - Construction Worker Shortform 2012 (sf12cw)

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Cyanide Table CW-6: Cyanide Calculations

Spreadsheets designed by Andrew Friedmann, MassDEP

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Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk
Based on Construction Worker 18-25 years of age

Courtyard: 0-3 Foot Interval
 East End of Courtyard: 10/26/2016

ShortForm Version 10-12
 Vlookup Version v0315

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material (OHM)	EPC (mg/kg)	ELCR ingestion	ELCR dermal	ELCR inhalation GI	ELCR inhalation pulmonary	ELCR _{total}	Subchronic				HQ _{total}
							HQ _{ing}	HQ _{derm}	HQ _{inh-GI}	HQ _{inh}	
POLYCHLORINATED BIPHENYLS (PCBs)	7.39E+00	1.3E-07	1.3E-07	3.4E-09	2.0E-10	2.6E-07	1.8E-01	1.8E-01	4.7E-03	1.4E-02	3.8E-01
ALIPHATICS C9 to C18	2.34E+02						2.9E-04	5.8E-04	7.5E-06	1.5E-05	8.9E-04
ALIPHATICS C19 to C36	3.77E+02						7.7E-05	1.6E-04	2.0E-06		2.4E-04
AROMATICS C11 to C22	7.98E+02						9.8E-04	3.3E-03	2.5E-05	5.9E-05	4.4E-03
ACENAPHTHENE	6.24E-01						1.2E-06	3.9E-06	3.0E-08	4.6E-08	5.1E-06
ACENAPHTHYLENE	2.17E-01						2.7E-07	9.0E-07	6.9E-09	1.6E-08	1.2E-06
ANTHRACENE	1.24E+00						4.6E-07	1.5E-06	1.2E-08	9.2E-08	2.1E-06
BENZO(a)ANTHRACENE	2.57E+00	4.9E-09	3.3E-09	1.3E-10	1.4E-10	8.5E-09	3.2E-06	2.1E-06	8.2E-08	1.9E-07	5.6E-06
BENZO(a)PYRENE	2.35E+00	4.5E-08	3.0E-08	1.2E-09	1.3E-09	7.8E-08	2.9E-06	1.9E-06	7.5E-08	1.8E-07	5.1E-06
BENZO(b)FLUORANTHENE	3.26E+00	6.3E-09	4.2E-09	1.6E-10	1.8E-10	1.1E-08	4.0E-06	2.7E-06	1.0E-07	2.4E-07	7.1E-06
BENZO(g,h,i)PERYLENE	1.40E+00						1.7E-06	5.8E-06	4.5E-08	1.0E-07	7.7E-06
BENZO(k)FLUORANTHENE	1.30E+00	2.5E-10	1.7E-10	6.5E-12	7.2E-12	4.3E-10	1.6E-06	1.1E-06	4.1E-08	9.7E-08	2.8E-06
CHRYSENE	3.03E+00	5.8E-10	3.9E-10	1.5E-11	1.7E-11	1.0E-09	3.7E-06	2.5E-06	9.7E-08	2.3E-07	6.6E-06
DIBENZO(a,h)ANTHRACENE	5.24E-01	1.0E-08	6.8E-09	2.6E-10	2.9E-10	1.7E-08	6.5E-07	4.3E-07	1.7E-08	3.9E-08	1.1E-06
FLUORANTHENE	7.27E+00						2.7E-05	9.0E-05	7.0E-07	5.4E-07	1.2E-04
FLUORENE	7.04E-01						6.5E-07	2.2E-06	1.7E-08	5.2E-08	2.9E-06
INDENO(1,2,3-cd)PYRENE	1.50E+00	2.9E-09	1.9E-09	7.5E-11	8.3E-11	5.0E-09	1.8E-06	1.2E-06	4.8E-08	1.1E-07	3.2E-06
METHYLNAPHTHALENE, 2-	1.27E+00						1.2E-04	3.9E-04	3.0E-06	9.5E-08	5.1E-04
NAPHTHALENE	3.52E-01						6.5E-07	2.2E-06	1.7E-08	4.4E-06	7.2E-06
PHENANTHRENE	5.86E+00						7.2E-06	2.4E-05	1.9E-07	4.4E-07	3.2E-05
PYRENE	6.38E+00						7.9E-06	2.6E-05	2.0E-07	4.8E-07	3.5E-05
BARIUM	3.84E+01						6.8E-04	6.8E-04	1.8E-05	2.9E-04	1.7E-03
MERCURY	3.80E-01						7.8E-04	1.6E-03	2.0E-05	4.7E-05	2.4E-03
VANADIUM	3.89E+01						5.3E-03	5.4E-03	1.4E-04	1.4E-03	1.2E-02
AROMATICS C9 to C10	4.59E+00						1.9E-05	3.8E-05	4.9E-07	3.4E-07	5.8E-05
BENZENE	4.83E-02	2.3E-11	7.0E-12	6.0E-13	1.0E-13	3.1E-11	5.9E-06	1.8E-06	1.5E-07	1.8E-07	8.1E-06
TOLUENE	1.71E-01						2.6E-07	8.0E-08	6.8E-09	1.3E-09	3.5E-07
CHLORDANE	9.40E-02	2.9E-10	1.2E-10	7.5E-12	2.5E-12	4.1E-10	2.3E-04	9.3E-05	6.0E-06	5.0E-07	3.3E-04
DIELDRIN	2.90E-02	4.1E-09	4.1E-09	1.1E-10	3.5E-11	8.3E-09	7.1E-04	7.2E-04	1.9E-05	6.0E-06	1.5E-03
TCDD, 2,3,7,8- (equivalents)	2.44E-05	3.2E-08	3.2E-08	8.3E-10	2.1E-10	6.5E-08	4.3E-02	4.3E-02	1.1E-03	4.5E-04	8.8E-02

Construction Worker - Soil: Table CW-2

Equations to Calculate Cancer Risk for Construction Worker

Vlookup Version v0315

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c-derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh-GI} = LADD_{inh-GI} * CSF_{oral}$$

$$LADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{c-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	(mg/kg-day) ⁻¹
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{c-ing}	OHM-specific	dimensionless
RAF _{c-derm}	OHM-specific	dimensionless
RAF _{c-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _(lifetime)	25,550	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM ₁₀	60	µg/m ³

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Construction Worker - Soil: Table CW-3

Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0315

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral-subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral-subchronic}}$$

$$ADD_{dermal} = \frac{EPC * SA * AF * RAF_{nc-derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh-GI} = \frac{ADD_{inh-GI}}{RfD_{oral-subchronic}}$$

$$ADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{nc-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation-subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM-specific	dimensionless
RAF _{nc-derm}	OHM-specific	dimensionless
RAF _{nc-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _{noncancer}	182	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM10	60	µg/m ³

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Construction Worker - Soil: Table CW-4

Definitions and Exposure Factors

Vlookup Version v0315

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	mg/kg	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF _{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
ED _{ing,derm} - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED _{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
AP _(lifetime) - Averaging Period for lifetime	25,550	days	Represents 70 years
AP _(noncancer) - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
AF - Adherence Factor	0.29	mg/cm ²	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR _{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm ² /day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
IFAF _{inh-gi} - Ingestion Fraction Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
IFAF _{inh} - Inhalation Fraction Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM ₁₀	60	µg/m ³	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0315

Oil or Hazardous Material	Oral CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	RAF _{c-inh}	Inhalation CSF (mg/kg-day) ⁻¹	Subchronic Oral RfD mg/kg-day	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}	Subchronic RAF _{nc-inh}	Subchronic Inhalation RfD
POLYCHLORINATED BIPHENYLS (PCBs)	2.0E+00					5.0E-05	1	0.1	1	5.7E-06
ALIPHATICS C9 to C18						1.0E+00	1	0.2	1	1.7E-01
ALIPHATICS C19 to C36						6.0E+00	1	0.2		
AROMATICS C11 to C22						3.0E-01	0.3	0.1	1	1.4E-01
ACENAPHTHENE						2.0E-01	0.3	0.1	1	1.4E-01
ACENAPHTHYLENE						3.0E-01	0.3	0.1	1	1.4E-01
ANTHRACENE						1.0E+00	0.3	0.1	1	1.4E-01
BENZO(a)ANTHRACENE	7.3E-01	0.3	0.02	1	7.3E-01	3.0E-01	0.3	0.02	1	1.4E-01
BENZO(a)PYRENE	7.3E+00	0.3	0.02	1	7.3E+00	3.0E-01	0.3	0.02	1	1.4E-01
BENZO(b)FLUORANTHENE	7.3E-01	0.3	0.02	1	7.3E-01	3.0E-01	0.3	0.02	1	1.4E-01
BENZO(g,h,i)PERYLENE						3.0E-01	0.3	0.1	1	1.4E-01
BENZO(k)FLUORANTHENE	7.3E-02	0.3	0.02	1	7.3E-02	3.0E-01	0.3	0.02	1	1.4E-01
CHRYSENE	7.3E-02	0.3	0.02	1	7.3E-02	3.0E-01	0.3	0.02	1	1.4E-01
DIBENZO(a,h)ANTHRACENE	7.3E+00	0.3	0.02	1	7.3E+00	3.0E-01	0.3	0.02	1	1.4E-01
FLUORANTHENE						1.0E-01	0.3	0.1	1	1.4E-01
FLUORENE						4.0E-01	0.3	0.1	1	1.4E-01
INDENO(1,2,3-cd)PYRENE	7.3E-01	0.3	0.02	1	7.3E-01	3.0E-01	0.3	0.02	1	1.4E-01
METHYLNAPHTHALENE, 2-						4.0E-03	0.3	0.1	1	1.4E-01
NAPHTHALENE						2.0E-01	0.3	0.1	1	8.6E-04
PHENANTHRENE						3.0E-01	0.3	0.1	1	1.4E-01
PYRENE						3.0E-01	0.3	0.1	1	1.4E-01
BARIUM						7.0E-02	1	0.1	1	1.4E-03
MERCURY						3.0E-04	0.5	0.1	1	8.6E-05
VANADIUM						9.0E-03	1	0.1	1	2.9E-04
AROMATICS C9 to C10						3.0E-01	1	0.2	1	1.4E-01
BENZENE	5.5E-02	1	0.03	1	2.7E-02	1.0E-02	1	0.03	1	2.9E-03
TOLUENE						8.0E-01	1	0.03	1	1.4E+00
CHLORDANE	3.5E-01	1	0.04	1	3.5E-01	5.0E-04	1	0.04	1	2.0E-03

Method 3 Risk Assessment for Chemicals in Soil - Construction Worker Shortform 2012 (sf12cw)

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Chem Table CW-5: Chemical-specific data

Cyanide Table CW-6: Cyanide Calculations

Spreadsheets designed by Andrew Friedmann, MassDEP

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Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk
Based on Construction Worker 18-25 years of age

Courtyard: 3-6 Foot Interval
 East End of Courtyard: 10/26/2016

ShortForm Version 10-12
 Vlookup Version v0315

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material (OHM)	EPC (mg/kg)	ELCR ingestion	ELCR dermal	ELCR inhalation GI	ELCR inhalation pulmonary	ELCR _{total}	Subchronic				HQ _{total}
							HQ _{ing}	HQ _{derm}	HQ _{inh-GI}	HQ _{inh}	
POLYCHLORINATED BIPHENYLS (PCBs)	9.80E+00	1.7E-07	1.7E-07	4.5E-09	2.6E-10	3.5E-07	2.4E-01	2.4E-01	6.3E-03	1.8E-02	5.1E-01
ALIPHATICS C9 to C18	4.72E+02						5.8E-04	1.2E-03	1.5E-05	2.9E-05	1.8E-03
ALIPHATICS C19 to C36	8.47E+02						1.7E-04	3.5E-04	4.5E-06		5.3E-04
AROMATICS C11 to C22	1.44E+00						1.8E-06	6.0E-06	4.6E-08	1.1E-07	7.9E-06
ACENAPHTHENE	1.21E+00						2.2E-06	7.5E-06	5.8E-08	9.0E-08	9.9E-06
ACENAPHTHYLENE	5.68E-01						7.0E-07	2.3E-06	1.8E-08	4.2E-08	3.1E-06
ANTHRACENE	1.44E+00						5.3E-07	1.8E-06	1.4E-08	1.1E-07	2.4E-06
BENZO(a)ANTHRACENE	2.08E+00	4.0E-09	2.7E-09	1.0E-10	1.2E-10	6.9E-09	2.6E-06	1.7E-06	6.6E-08	1.5E-07	4.5E-06
BENZO(a)PYRENE	1.60E+00	3.1E-08	2.1E-08	8.0E-10	8.9E-10	5.3E-08	2.0E-06	1.3E-06	5.1E-08	1.2E-07	3.5E-06
BENZO(b)FLUORANTHENE	1.92E+00	3.7E-09	2.5E-09	9.6E-11	1.1E-10	6.4E-09	2.4E-06	1.6E-06	6.1E-08	1.4E-07	4.2E-06
BENZO(g,h,i)PERYLENE	1.09E+00						1.3E-06	4.5E-06	3.5E-08	8.1E-08	6.0E-06
BENZO(k)FLUORANTHENE	1.07E+00	2.1E-10	1.4E-10	5.3E-12	5.9E-12	3.5E-10	1.3E-06	8.8E-07	3.4E-08	8.0E-08	2.3E-06
CHRYSENE	2.53E+00	4.9E-10	3.3E-10	1.3E-11	1.4E-11	8.4E-10	3.1E-06	2.1E-06	8.1E-08	1.9E-07	5.5E-06
DIBENZO(a,h)ANTHRACENE	7.24E-01	1.4E-08	9.3E-09	3.6E-10	4.0E-10	2.4E-08	8.9E-07	6.0E-07	2.3E-08	5.4E-08	1.6E-06
FLUORANTHENE	5.74E+00						2.1E-05	7.1E-05	5.5E-07	4.3E-07	9.3E-05
FLUORENE	2.10E+00						1.9E-06	6.5E-06	5.0E-08	1.6E-07	8.7E-06
INDENO(1,2,3-cd)PYRENE	1.17E+00	2.2E-09	1.5E-09	5.8E-11	6.5E-11	3.9E-09	1.4E-06	9.7E-07	3.7E-08	8.7E-08	2.5E-06
METHYLNAPHTHALENE, 2-	6.62E+00						6.1E-04	2.1E-03	1.6E-05	4.9E-07	2.7E-03
NAPHTHALENE	1.60E+00						3.0E-06	9.9E-06	7.7E-08	2.0E-05	3.3E-05
PHENANTHRENE	8.78E+00						1.1E-05	3.6E-05	2.8E-07	6.5E-07	4.8E-05
PYRENE	8.58E+00						1.1E-05	3.5E-05	2.7E-07	6.4E-07	4.7E-05
BARIUM	2.70E+01						4.8E-04	4.8E-04	1.2E-05	2.0E-04	1.2E-03
MERCURY	5.60E-02						1.1E-04	2.3E-04	3.0E-06	7.0E-06	3.6E-04
VANADIUM	2.43E+01						3.3E-03	3.3E-03	8.6E-05	9.0E-04	7.7E-03
AROMATICS C9 to C10	4.95E+00						2.0E-05	4.1E-05	5.3E-07	3.7E-07	6.2E-05
BENZENE	5.80E-02	2.8E-11	8.5E-12	7.3E-13	1.2E-13	3.7E-11	7.1E-06	2.2E-06	1.9E-07	2.2E-07	9.7E-06
TOLUENE	3.20E-01						4.9E-07	1.5E-07	1.3E-08	2.4E-09	6.6E-07
CHLORDANE	7.55E-01	2.3E-09	9.3E-10	6.0E-11	2.0E-11	3.3E-09	1.9E-03	7.5E-04	4.8E-05	4.0E-06	2.7E-03
DIELDRIN	1.51E-01	2.1E-08	2.1E-08	5.5E-10	1.8E-10	4.3E-08	3.7E-03	3.7E-03	9.6E-05	3.1E-05	7.6E-03
TCDD, 2,3,7,8- (equivalents)	3.23E-05	4.3E-08	4.3E-08	1.1E-09	2.8E-10	8.7E-08	5.7E-02	5.7E-02	1.5E-03	6.0E-04	1.2E-01

Construction Worker - Soil: Table CW-2

Equations to Calculate Cancer Risk for Construction Worker

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Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c-derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh-GI} = LADD_{inh-GI} * CSF_{oral}$$

$$LADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{c-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	(mg/kg-day) ⁻¹
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{c-ing}	OHM-specific	dimensionless
RAF _{c-derm}	OHM-specific	dimensionless
RAF _{c-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _(lifetime)	25,550	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM ₁₀	60	µg/m ³

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Construction Worker - Soil: Table CW-3

Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0315

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral-subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral-subchronic}}$$

$$ADD_{dermal} = \frac{EPC * SA * AF * RAF_{nc-derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh-GI} = \frac{ADD_{inh-GI}}{RfD_{oral-subchronic}}$$

$$ADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{nc-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation-subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM-specific	dimensionless
RAF _{nc-derm}	OHM-specific	dimensionless
RAF _{nc-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _{noncancer}	182	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM10	60	µg/m ³

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Construction Worker - Soil: Table CW-4

Definitions and Exposure Factors

Vlookup Version v0315

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	mg/kg	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF _{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
ED _{ing,derm} - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED _{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
AP _(lifetime) - Averaging Period for lifetime	25,550	days	Represents 70 years
AP _(noncancer) - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
AF - Adherence Factor	0.29	mg/cm ²	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR _{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm ² /day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
IFAF _{inh-gi} - Ingestion Fraction Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
IFAF _{inh} - Inhalation Fraction Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM ₁₀	60	µg/m ³	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0315

Oil or Hazardous Material	Oral CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	RAF _{c-inh}	Inhalation CSF (mg/kg-day) ⁻¹	Subchronic Oral RfD mg/kg-day	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}	Subchronic RAF _{nc-inh}	Subchronic Inhalation RfD
POLYCHLORINATED BIPHENYLS (PCBs)	2.0E+00					5.0E-05	1	0.1	1	5.7E-06
ALIPHATICS C9 to C18						1.0E+00	1	0.2	1	1.7E-01
ALIPHATICS C19 to C36						6.0E+00	1	0.2		
AROMATICS C11 to C22						3.0E-01	0.3	0.1	1	1.4E-01
ACENAPHTHENE						2.0E-01	0.3	0.1	1	1.4E-01
ACENAPHTHYLENE						3.0E-01	0.3	0.1	1	1.4E-01
ANTHRACENE						1.0E+00	0.3	0.1	1	1.4E-01
BENZO(a)ANTHRACENE	7.3E-01	0.3	0.02	1	7.3E-01	3.0E-01	0.3	0.02	1	1.4E-01
BENZO(a)PYRENE	7.3E+00	0.3	0.02	1	7.3E+00	3.0E-01	0.3	0.02	1	1.4E-01
BENZO(b)FLUORANTHENE	7.3E-01	0.3	0.02	1	7.3E-01	3.0E-01	0.3	0.02	1	1.4E-01
BENZO(g,h,i)PERYLENE						3.0E-01	0.3	0.1	1	1.4E-01
BENZO(k)FLUORANTHENE	7.3E-02	0.3	0.02	1	7.3E-02	3.0E-01	0.3	0.02	1	1.4E-01
CHRYSENE	7.3E-02	0.3	0.02	1	7.3E-02	3.0E-01	0.3	0.02	1	1.4E-01
DIBENZO(a,h)ANTHRACENE	7.3E+00	0.3	0.02	1	7.3E+00	3.0E-01	0.3	0.02	1	1.4E-01
FLUORANTHENE						1.0E-01	0.3	0.1	1	1.4E-01
FLUORENE						4.0E-01	0.3	0.1	1	1.4E-01
INDENO(1,2,3-cd)PYRENE	7.3E-01	0.3	0.02	1	7.3E-01	3.0E-01	0.3	0.02	1	1.4E-01
METHYLNAPHTHALENE, 2-						4.0E-03	0.3	0.1	1	1.4E-01
NAPHTHALENE						2.0E-01	0.3	0.1	1	8.6E-04
PHENANTHRENE						3.0E-01	0.3	0.1	1	1.4E-01
PYRENE						3.0E-01	0.3	0.1	1	1.4E-01
BARIUM						7.0E-02	1	0.1	1	1.4E-03
MERCURY						3.0E-04	0.5	0.1	1	8.6E-05
VANADIUM						9.0E-03	1	0.1	1	2.9E-04
AROMATICS C9 to C10						3.0E-01	1	0.2	1	1.4E-01
BENZENE	5.5E-02	1	0.03	1	2.7E-02	1.0E-02	1	0.03	1	2.9E-03
TOLUENE						8.0E-01	1	0.03	1	1.4E+00
CHLORDANE	3.5E-01	1	0.04	1	3.5E-01	5.0E-04	1	0.04	1	2.0E-03

Method 3 Risk Assessment for Chemicals in Soil - Construction Worker Shortform 2012 (sf12cw)

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Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk
Based on Construction Worker 18-25 years of age

Courtyard: 6-20 Foot Interval
 East End of Courtyard: 10/26/2016

ShortForm Version 10-12
 Vlookup Version v0315

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

ELCR (all chemicals) = 1.4E-07
 HI (all chemicals) = 2.5E-01

Oil or Hazardous Material (OHM)	EPC (mg/kg)	ELCR ingestion	ELCR dermal	ELCR inhalation GI	ELCR inhalation pulmonary	ELCR _{total}	Subchronic				HQ _{total}
							HQ _{ing}	HQ _{derm}	HQ _{inh-GI}	HQ _{inh}	
POLYCHLORINATED BIPHENYLS (PCBs)	9.97E-01	1.7E-08	1.8E-08	4.5E-10	2.6E-11	3.6E-08	2.5E-02	2.5E-02	6.4E-04	1.9E-03	5.2E-02
ALIPHATICS C9 to C18	6.38E+02						7.9E-04	1.6E-03	2.0E-05	4.0E-05	2.4E-03
ALIPHATICS C19 to C36	1.21E+03						2.5E-04	5.0E-04	6.4E-06		7.6E-04
AROMATICS C11 to C22	1.80E+03						2.2E-03	7.4E-03	5.7E-05	1.3E-04	9.8E-03
ACENAPHTHENE	3.14E-01						5.8E-07	1.9E-06	1.5E-08	2.3E-08	2.6E-06
ACENAPHTHYLENE	2.38E-01						2.9E-07	9.8E-07	7.6E-09	1.8E-08	1.3E-06
ANTHRACENE	1.22E+00						4.5E-07	1.5E-06	1.2E-08	9.1E-08	2.1E-06
BENZO(a)ANTHRACENE	1.14E+00	2.2E-09	1.5E-09	5.7E-11	6.3E-11	3.8E-09	1.4E-06	9.4E-07	3.6E-08	8.5E-08	2.5E-06
BENZO(a)PYRENE	8.78E-01	1.7E-08	1.1E-08	4.4E-10	4.9E-10	2.9E-08	1.1E-06	7.3E-07	2.8E-08	6.5E-08	1.9E-06
BENZO(b)FLUORANTHENE	1.09E+00	2.1E-09	1.4E-09	5.4E-11	6.0E-11	3.6E-09	1.3E-06	9.0E-07	3.5E-08	8.1E-08	2.4E-06
BENZO(g,h,i)PERYLENE	5.09E-01						6.3E-07	2.1E-06	1.6E-08	3.8E-08	2.8E-06
BENZO(k)FLUORANTHENE	5.22E-01	1.0E-10	6.7E-11	2.6E-12	2.9E-12	1.7E-10	6.4E-07	4.3E-07	1.7E-08	3.9E-08	1.1E-06
CHRYSENE	1.27E+00	2.4E-10	1.6E-10	6.3E-12	7.0E-12	4.2E-10	1.6E-06	1.1E-06	4.1E-08	9.5E-08	2.7E-06
DIBENZO(a,h)ANTHRACENE	2.83E-01	5.4E-09	3.7E-09	1.4E-10	1.6E-10	9.4E-09	3.5E-07	2.3E-07	9.0E-09	2.1E-08	6.1E-07
FLUORANTHENE	3.38E+00						1.2E-05	4.2E-05	3.2E-07	2.5E-07	5.5E-05
FLUORENE	2.31E+00						2.1E-06	7.2E-06	5.5E-08	1.7E-07	9.5E-06
INDENO(1,2,3-cd)PYRENE	5.70E-01	1.1E-09	7.4E-10	2.8E-11	3.2E-11	1.9E-09	7.0E-07	4.7E-07	1.8E-08	4.2E-08	1.2E-06
METHYLNAPHTHALENE, 2-	3.75E+00						3.5E-04	1.2E-03	9.0E-06	2.8E-07	1.5E-03
NAPHTHALENE	1.75E+00						3.2E-06	1.1E-05	8.4E-08	2.2E-05	3.6E-05
PHENANTHRENE	4.28E+00						5.3E-06	1.8E-05	1.4E-07	3.2E-07	2.3E-05
PYRENE	2.50E+00						3.1E-06	1.0E-05	8.0E-08	1.9E-07	1.4E-05
BARIUM	2.70E+01						4.8E-04	4.8E-04	1.2E-05	2.0E-04	1.2E-03
MERCURY	2.43E+01						5.0E-02	1.0E-01	1.3E-03	3.0E-03	1.5E-01
VANADIUM	2.83E+01						3.9E-03	3.9E-03	1.0E-04	1.1E-03	8.9E-03
AROMATICS C9 to C10	7.83E+01						3.2E-04	6.5E-04	8.3E-06	5.8E-06	9.8E-04
BENZENE	2.70E-01	1.3E-10	3.9E-11	3.4E-12	5.6E-13	1.7E-10	3.3E-05	1.0E-05	8.6E-07	1.0E-06	4.5E-05
TOLUENE	1.40E-01						2.2E-07	6.5E-08	5.6E-09	1.0E-09	2.9E-07
CHLORDANE	7.55E-01	2.3E-09	9.3E-10	6.0E-11	2.0E-11	3.3E-09	1.9E-03	7.5E-04	4.8E-05	4.0E-06	2.7E-03
DIELDRIN	1.51E-01	2.1E-08	2.1E-08	5.5E-10	1.8E-10	4.3E-08	3.7E-03	3.7E-03	9.6E-05	3.1E-05	7.6E-03
TCDD, 2,3,7,8- (equivalents)	3.29E-06	4.3E-09	4.4E-09	1.1E-10	2.9E-11	8.8E-09	5.8E-03	5.8E-03	1.5E-04	6.1E-05	1.2E-02

Construction Worker - Soil: Table CW-2

Equations to Calculate Cancer Risk for Construction Worker

Vlookup Version v0315

Cancer Risk from Ingestion

$$ELCR_{ing} = LADD_{ing} * CSF_{oral}$$

$$LADD_{ing} = \frac{EPC * IR * RAF_{c-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Dermal Absorption

$$ELCR_{derm} = LADD_{derm} * CSF_{oral}$$

$$LADD_{derm} = \frac{EPC * SA * AF * RAF_{c-derm} * EF * ED_{derm} * EP * C1}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$ELCR_{inh-GI} = LADD_{inh-GI} * CSF_{oral}$$

$$LADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{c-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Cancer Risk from Particulate Inhalation - Pulmonary Absorption

$$ELCR_{inh} = LADD_{inh} * CSF_{inhalation}$$

$$LADD = \frac{EPC * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{c-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{lifetime}}$$

Parameter	Value	Units
CSF	OHM-specific	(mg/kg-day) ⁻¹
LADD	age/OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{c-ing}	OHM-specific	dimensionless
RAF _{c-derm}	OHM-specific	dimensionless
RAF _{c-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _(lifetime)	25,550	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM ₁₀	60	µg/m ³

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Construction Worker - Soil: Table CW-3

Equations to Calculate Noncancer Risk for Construction Worker

Vlookup Version v0315

Noncancer Risk from Ingestion

$$HQ_{ing} = \frac{ADD_{ing}}{RfD_{oral-subchronic}}$$

$$ADD_{ing} = \frac{EPC * IR * RAF_{nc-ing} * EF * ED_{ing} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Dermal Absorption

$$HQ_{derm} = \frac{ADD_{derm}}{RfD_{oral-subchronic}}$$

$$ADD_{dermal} = \frac{EPC * SA * AF * RAF_{nc-derm} * EF * ED_{dermal} * EP * C1}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Gastrointestinal Absorption

$$HQ_{inh-GI} = \frac{ADD_{inh-GI}}{RfD_{oral-subchronic}}$$

$$ADD_{inh-GI} = \frac{EPC * RCAF_{inh-gi} * PM_{10} * VR_{work} * RAF_{nc-ing} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Noncancer Risk from Particulate Inhalation - Pulmonary Absorption

$$HQ_{inh} = \frac{ADD}{RfD_{inhalation-subchronic}}$$

$$ADD_{inh} = \frac{EPC_{soil} * RCAF_{inh} * PM_{10} * VR_{work} * RAF_{nc-inh} * EF * ED_{inh} * EP * C2 * C3 * C4}{BW * AP_{noncancer}}$$

Parameter	Value	Units
RfD	OHM-specific	mg/kg-day
ADD	OHM-specific	mg/kg-day
EPC	OHM-specific	mg/kg
IR	100	mg/day
RAF _{nc-ing}	OHM-specific	dimensionless
RAF _{nc-derm}	OHM-specific	dimensionless
RAF _{nc-inh}	OHM-specific	dimensionless
EF	0.714	event/day
ED _{ing & derm}	1	day/event
ED _{inh}	0.333	day/event
EP	182	days
C1	1.0E-06	kg/mg
C2	1.0E-09	kg/µg
C3	1440	min/days
C4	1.0E-03	m ³ /L
BW	58.0	kg
AP _{noncancer}	182	days
VR _{work}	60	L/min
AF	0.29	mg/cm ²
SA	3473	cm ² /day
RCAF _{inh-gi}	1.5	dimensionless
RCAF _{inh}	0.5	dimensionless
PM10	60	µg/m ³

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Construction Worker - Soil: Table CW-4

Definitions and Exposure Factors

Vlookup Version v0315

Parameter	Value	Units	Notes
ELCR - Excess Lifetime Cancer Risk	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
HI - Hazard Index	chemical specific	dimensionless	Pathway specific (ing =ingestion, derm=dermal, inh=inhalation)
CSF - Cancer Slope Factor	chemical specific	(mg/kg-day) ⁻¹	see Table CW-5.
RfD - Reference Dose	chemical specific	mg/kg-day	see Table CW-5.
LADD - Lifetime Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-2.
ADD - Average Daily Dose	chemical specific	mg/kg-day	Pathway specific. See Table CW-3.
EPC - Exposure Point Concentration	chemical specific	mg/kg	see Table CW-1.
IR - Soil Ingestion Rate	100	mg/day	MADEP. 2002. Technical Update: Calculation of an Enhanced Soil Ingestion Rate. (http://www.mass.gov/dep/ors/orspubs.htm).
RAF _c - Relative Absorption Factor for Cancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
RAF _{nc} - Relative Absorption Factor for Noncancer Effects	chemical specific	dimensionless	Pathway specific - see Table CW-5.
EF - Exposure Frequency	0.714	event/day	5 events (days) / 7 events (days) in a week; MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-38.
ED _{ing,derm} - Exposure Duration for ingestion or dermal exposure	1	day/event	
ED _{inh} - Exposure Duration for inhalation exposure	0.333	day/event	Represents 8 hours / event.
EP - Exposure Period	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
BW - Body Weight	58.0	kg	U.S. EPA. 1997. Exposure Factors Handbook. Table 7-7, Females, ages 18 - 25.
AP _(lifetime) - Averaging Period for lifetime	25,550	days	Represents 70 years
AP _(noncancer) - Averaging Period for noncancer	182	days	6 months; MADEP 1995 Guidance for Disposal Site Risk Characterization.
AF - Adherence Factor	0.29	mg/cm ²	MA DEP. 2002 Technical Update: Weighted Skin-Soil Adherence Factors. (http://www.mass.gov/dep/ors/orspubs.htm)
VR _{work} - Ventilation Rate during work (heavy exertion)	60	L/min	Table B-4 MADEP 1995 Guidance for Disposal Site Risk Characterization.
SA - Surface Area	3473	cm ² /day	MADEP. 1995. Guidance for Disposal Site Risk Characterization. 50th percentile for females. Appendix Table B-2.
IFAF _{inh-gi} - Ingestion Fraction Adjustment Factor, gastrointestinal	1.5	dimensionless	MADEP 2007. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
IFAF _{inh} - Inhalation Fraction Adjustment Factor, inhalation	0.5	dimensionless	MADEP 2002. Characterization of Risks Due to Inhalation of Particulates by Construction Workers
PM10 - Concentration of PM ₁₀	60	µg/m ³	MADEP 1995 Guidance for Disposal Site Risk Characterization pg B-11

Construction Worker - Soil: Table CW-5
Chemical-Specific Data

Vlookup Version v0315

Oil or Hazardous Material	Oral CSF (mg/kg-day) ⁻¹	RAF _{c-ing}	RAF _{c-derm}	RAF _{c-inh}	Inhalation CSF (mg/kg-day) ⁻¹	Subchronic Oral RfD mg/kg-day	Subchronic RAF _{nc-ing}	Subchronic RAF _{nc-derm}	Subchronic RAF _{nc-inh}	Subchronic Inhalation RfD
POLYCHLORINATED BIPHENYLS (PCBs)	2.0E+00					5.0E-05	1	0.1	1	5.7E-06
ALIPHATICS C9 to C18						1.0E+00	1	0.2	1	1.7E-01
ALIPHATICS C19 to C36						6.0E+00	1	0.2		
AROMATICS C11 to C22						3.0E-01	0.3	0.1	1	1.4E-01
ACENAPHTHENE						2.0E-01	0.3	0.1	1	1.4E-01
ACENAPHTHYLENE						3.0E-01	0.3	0.1	1	1.4E-01
ANTHRACENE						1.0E+00	0.3	0.1	1	1.4E-01
BENZO(a)ANTHRACENE	7.3E-01	0.3	0.02	1	7.3E-01	3.0E-01	0.3	0.02	1	1.4E-01
BENZO(a)PYRENE	7.3E+00	0.3	0.02	1	7.3E+00	3.0E-01	0.3	0.02	1	1.4E-01
BENZO(b)FLUORANTHENE	7.3E-01	0.3	0.02	1	7.3E-01	3.0E-01	0.3	0.02	1	1.4E-01
BENZO(g,h,i)PERYLENE						3.0E-01	0.3	0.1	1	1.4E-01
BENZO(k)FLUORANTHENE	7.3E-02	0.3	0.02	1	7.3E-02	3.0E-01	0.3	0.02	1	1.4E-01
CHRYSENE	7.3E-02	0.3	0.02	1	7.3E-02	3.0E-01	0.3	0.02	1	1.4E-01
DIBENZO(a,h)ANTHRACENE	7.3E+00	0.3	0.02	1	7.3E+00	3.0E-01	0.3	0.02	1	1.4E-01
FLUORANTHENE						1.0E-01	0.3	0.1	1	1.4E-01
FLUORENE						4.0E-01	0.3	0.1	1	1.4E-01
INDENO(1,2,3-cd)PYRENE	7.3E-01	0.3	0.02	1	7.3E-01	3.0E-01	0.3	0.02	1	1.4E-01
METHYLNAPHTHALENE, 2-						4.0E-03	0.3	0.1	1	1.4E-01
NAPHTHALENE						2.0E-01	0.3	0.1	1	8.6E-04
PHENANTHRENE						3.0E-01	0.3	0.1	1	1.4E-01
PYRENE						3.0E-01	0.3	0.1	1	1.4E-01
BARIUM						7.0E-02	1	0.1	1	1.4E-03
MERCURY						3.0E-04	0.5	0.1	1	8.6E-05
VANADIUM						9.0E-03	1	0.1	1	2.9E-04
AROMATICS C9 to C10						3.0E-01	1	0.2	1	1.4E-01
BENZENE	5.5E-02	1	0.03	1	2.7E-02	1.0E-02	1	0.03	1	2.9E-03
TOLUENE						8.0E-01	1	0.03	1	1.4E+00
CHLORDANE	3.5E-01	1	0.04	1	3.5E-01	5.0E-04	1	0.04	1	2.0E-03

Table 2.4
Cancer Dose Response Values:
Oral Slope Factors

Chemical Name	CAS Number	Oral Slope Factor 1/(mg/kg/day)	Weight of Evidence Class	Source	Date Last Revised
acenaphthene	83-32-9			MADEP, 6/14	
acenaphthylene	208-96-8		D	MADEP, 6/14	
anthracene	120-12-7		D	MADEP, 6/14	
bartum	7440-39-3			MADEP, 6/14	
benzene	71-43-2	5.5E-02	A	MADEP, 6/14	
benzo(a)anthracene	56-55-3	7.3E-01	B2	MADEP, 6/14	
benzo(a)pyrene	50-32-8	7.3E+00	B2	MADEP, 6/14	
benzo(b)fluoranthene	205-99-2	7.3E-01	B2	MADEP, 6/14	
benzo(k)fluoranthene	207-08-9	7.3E-02	B2	MADEP, 6/14	
benzo(ghi)perylene	191-24-2			MADEP, 6/14	
beryllium	7440-41-7		B1	MADEP, 6/14	
cadmium	7440-43-9		B1	MADEP, 6/14	
chlordane	57-74-9	3.5E-01	B2	MADEP, 6/14	
chromium (III)	16065-83-1			MADEP, 6/14	
chrysene	218-01-9	7.3E-02	B2	MADEP, 6/14	
dibenzo(a,h)anthracene	53-70-3	7.3E+00	B2	MADEP, 6/14	
DDE	72-55-9	3.4E-01	B2	MADEP, 6/14	
DDT	50-29-3	3.4E-01	B2	MADEP, 6/14	
die�drin	60-57-1	1.6E+01	B2	MADEP, 6/14	
dioxin (TCDD equivalents)	1746-01-6	1.5E+05	B2	MADEP, 6/14	
fluoranthene	206-44-0		D	MADEP, 6/14	
fluorene	86-73-7			MADEP, 6/14	
indeno(1,2,3-cd)pyrene	193-39-5	7.3E-01	B2	MADEP, 6/14	
lead	7439-92-1		B2	MADEP, 6/14	
mercury	7439-97-6		D	MADEP, 12/09	
2-methylnaphthalene	91-57-6			MADEP, 6/14	
naphthalene	91-20-3			MADEP, 6/14	
nickel	7440-02-0		A	MADEP, 6/14	
phenanthrene	85-01-8		D	MADEP, 6/14	
polychlorinated biphenyls	1336-36-3	2.0E+00	B2	MADEP, 6/14	
pyrene	129-00-0		D	MADEP, 6/14	
thallium	7440-28-0			MADEP, 6/14	
toluene	108-88-3		D	MADEP, 6/14	
vanadium	7440-62-2			MADEP, 6/14	
zinc	7440-66-6		D	MADEP, 6/14	
C9-C18 Aliphatics	N/A			MADEP, 6/14	
C19-C36 Aliphatics	N/A			MADEP, 6/14	
C9-C10 Aromatics	N/A		No Data	MADEP, 5/09	
C11-C22 Aromatics	N/A			MADEP, 6/14	

Notes:

mg/kg/day = milligrams per kilogram body weight per day

N/A = not available

Weight of Evidence:

A = Human carcinogen

B1 = Probable human carcinogen

B2 = Probable human carcinogen

C = Possible human carcinogen

D = Not classifiable as to human carcinogenicity

E = Evidence of noncarcinogenicity for humans

References:

MADEP, 6/14. MCP Toxicity excel spreadsheet used for the development of the MCP Numerical Standards

Table 2.5
Cancer Dose Response Values:
Inhalation Unit Risks Factors

Chemical Name	CAS Number	Unit Risk Factor 1/(mg/cu. m)	Weight of Evidence Class	Source	Date Last Revised
acenaphthene	83-32-9			MADEP 6/14	
acenaphthylene	208-96-8		D	MADEP 6/14	
anthracene	120-12-7		D	MADEP 6/14	
barium	7440-39-3			MADEP 6/14	
benzene	71-43-2	7.8E-03	A	MADEP 6/14	
benzo(a)anthracene	56-55-3	2.1E-01	B2	MADEP 6/14	
benzo(a)pyrene	50-32-8	2.1E+00	B2	MADEP 6/14	
benzo(b)fluoranthene	205-99-2	2.1E-01	B2	MADEP 6/14	
benzo(k)fluoranthene	207-08-9	2.1E-02	B2	MADEP 6/14	
benzo(ghi)perylene	191-24-2			MADEP 6/14	
beryllium	7440-41-7	2.4E+00	B1	MADEP 6/14	
cadmium	7440-43-9	1.8E+00	B1	MADEP 6/14	
chlordane	57-74-9	1.0E-01	B2	MADEP 6/14	
chromium (III)	16065-83-1			MADEP 6/14	
chrysene	218-01-9	2.1E-02	B2	MADEP 6/14	
dibenzo(a,h)anthracene	53-70-3	2.1E+00	B2	MADEP 6/14	
DDF	72-55-9	9.7E-02	B2	MADEP 6/14	
DDT	50-29-3	9.7E-02	B2	MADEP 6/14	
dieletrin	60-57-1	4.6E+00	B2	MADEP 6/14	
dioxin (TCDD equivalents)	1746-01-6	3.5E+04	B2	MADEP 6/14	
fluoranthene	206-44-0		D	MADEP 6/14	
fluorene	86-73-7			MADEP 6/14	
indeno(1,2,3-cd)pyrene	193-39-5	2.1E-01	B2	MADEP 6/14	
lead	7439-92-1		B2	MADEP 6/14	
mercury	7439-97-6		D	MADEP 12/09	
2-methylnaphthalene	91-57-6			MADEP 6/14	
naphthalene	91-20-3			MADEP 6/14	
nickel	7440-02-0	4.8E-01	A	MADEP 6/14	
phenanthrene	85-01-8		D	MADEP 6/14	
polychlorinated biphenyls	1336-36-3	1.0E-01	B2	MADEP 6/14	
pyrene	129-00-0		D	MADEP 6/14	
thallium	7440-28-0			MADEP 6/14	
toluene	108-88-3		D	MADEP 6/14	
vanadium	7440-62-2			MADEP 6/14	
zinc	7440-66-6		D	MADEP 6/14	
C9-C18 Aliphatics	N/A			MADEP 6/14	
C19-C36 Aliphatics	N/A			MADEP 6/14	
C9-C10 Aromatics	N/A			MADEP 5/09	
C11-C22 Aromatics	N/A			MADEP 6/14	

Notes: mg/cu. m. = milligrams per cubic meter

Weight of Evidence:

A = Human carcinogen

B1 = Probable human carcinogen

B2 = Probable human carcinogen

C = Possible human carcinogen

D = Not classifiable as to human carcinogenicity

E = Evidence of noncarcinogenicity for humans

N/A = Not available

References:

MADEP, 6/14. MCP Toxicity excel spreadsheet used for the development of the MCP Numerical Standards

Table 2.6
Cancer Dose Response Values: Relative Absorption Factors (RAFs)

Chemical Name	CAS Number	Soil Ingestion RAF		Water Ingestion RAF	
		Cancer	Cancer	Cancer	Cancer
acenaphthene	83-32-9	NC	NC	NC	NC
acenaphthylene	208-96-8	NC	NC	NC	NC
anthracene	120-12-7	NC	NC	NC	NC
barium	7440-39-3	NC	NC	NC	NC
benzene	71-43-2	1	1	0.03	1
benzo(a)anthracene	56-55-3	0.3	1	0.02	1
benzo(a)pyrene	50-32-8	0.3	1	0.02	1
benzo(b)fluoranthene	205-99-2	0.3	1	0.02	1
benzo(k)fluoranthene	207-08-9	0.3	1	0.02	1
benzo(ghi)perylene	191-24-2	NC	NC	NC	NC
beryllium	7440-41-7	1	1	0.03	1
cadmium	7440-43-9	NC	NC	NC	NC
chromium (III)	16065-83-1	NC	NC	NC	NC
chrysene	218-01-9	0.3	1	0.02	1
dibenzo(a,h)anthracene	53-70-3	0.3	1	0.02	1
DDE	72-55-9	1	1	0.03	1
DDT	50-29-3	1	1	0.03	1
dieldrin	60-57-1	1	1	0.1	1
dioxin (TCDD equivalents)	1746-01-6	1	1	0.1	1
ethylbenzene	100-41-4	NC	NC	NC	NC
fluoranthene	206-44-0	NC	NC	NC	NC
fluorene	86-73-7	NC	NC	NC	NC
indeno(1,2,3-cd)pyrene	193-39-5	0.3	1	0.02	1
lead	7439-92-1	NC	NC	NC	NC
mercury	7439-97-6	NC	NC	NC	NC
2-methylnaphthalene	91-57-6	NC	NC	NC	NC
naphthalene	91-20-3	NC	NC	NC	NC
nickel	7440-02-0	NC	NC	NC	NC
phenanthrene	85-01-8	NC	NC	NC	NC
polychlorinated biphenyls	1336-36-3	1	1	0.1	1
pyrene	129-00-0	NC	NC	NC	NC
thallium	7440-28-0	NC	NC	NC	NC
toluene	108-88-3	NC	NC	NC	NC
vanadium	7440-62-2	NC	NC	NC	NC
zinc	7440-66-6	NC	NC	NC	NC
C9-C18 Aliphatics	N/A	NC	NC	NC	NC
C19-C36 Aliphatics	N/A	NC	NC	NC	NC
C9-C10 Aromatics	N/A	NC	NC	NC	NC
C11-C22 Aromatics	N/A	NC	NC	NC	NC

Notes:

(1) RAF values from MADEP (1994). Default value of one (1) assigned to dermal contact with water.
 NC = RAF not provided because compound is not a Class A, B1, B2 or, when applicable, C carcinogen
 N/A = not available or because no oral cancer slope factor is available.

References:

MADEP, 6/14. MCP Toxicity excel spreadsheet used for the development of the MCP Numerical Standards.

Table 3.3
Calculation of Lifetime Average Daily Dose for Soil Exposure: Resident, aged 1 to 2 Years (East End of Courtyard: 10/26/2016)

Receptor: Resident, aged 1-31 years			Exposure Point:		East End of Courtyard: 0-3 Foot Interval		East End of Courtyard: 3-6 Foot Interval		East End of Courtyard: 6-20 Foot Interval		0.00E+00		0.00E+00	
Chemical Name	CAS Number	Weight of Evidence Class	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion
benzene	71-43-2	A	2.42E-10	4.68E-09	2.90E-10	5.62E-09	3.15E-09	6.11E-08						
benzo(a)anthracene	50-37-3		8.37E-09	7.47E-08	6.94E-09	6.03E-08	8.87E-09	7.73E-08						
benzo(a)pyrene	50-32-8		7.84E-09	6.83E-08	5.34E-09	4.65E-08	6.83E-09	5.96E-08						
benzo(b)fluoranthene	205-99-2		1.09E-08	9.48E-08	6.40E-09	5.58E-08	8.48E-09	7.39E-08						
benzo(k)fluoranthene	207-08-9		4.67E-09	4.07E-08	3.64E-09	3.17E-08	4.06E-09	3.54E-08						
chlorodane	57-74-9		7.84E-10	9.11E-09	6.30E-09	7.32E-08	1.47E-08	1.71E-07						
chloroform	53-76-3		1.01E-08	8.93E-08	8.44E-09	7.36E-08	9.88E-09	8.62E-08						
dibenz(a,h)anthracene	53-70-3		1.73E-09	1.52E-08	2.41E-09	2.11E-08	2.20E-09	1.92E-08						
dieldrin	60-57-1		4.84E-10	2.81E-09	2.52E-09	1.46E-08	5.88E-09	3.41E-08						
dioxin (TCDD equivalents)	1746-01-6		4.07E-13	2.36E-12	5.39E-13	3.13E-12	1.28E-13	7.44E-13						
indeno[1,2,3-cd]pyrene	193-39-5		5.00E-09	4.36E-08	3.90E-09	3.40E-08	4.46E-09	3.89E-08						
polychlorinated biphenyls	133-66-9		1.00E-07	1.00E-07			9.50E-07	3.88E-08						

Formula: Lifetime Average Daily Dose (LADD) for exposure to soils via ingestion (ing) and dermal contact	
LADD-dermal = $\frac{[OHM-soil]*SA*AF*RAF*EF*ED*EP*C}{BW*AP}$	Unit:
LADD-ing = $\frac{[OHM-soil]*IR*RAF*EF*ED*EP*C}{BW*AP}$	LADD, mg/kg/day
Receptor: Resident, aged 1 to 31 years	

Description	Abbreviation	Unit	Default Value	Source	Site-Specific Value	Source / Description	Input Value
Exposure point concentration	[OHM-soil]	mg/kg			See Soil EPC Table		See Soil EPC Table
Skin surface area in contact with soil on days exposed	SA	square centimeter/day		[1], child, aged 8 to 15 years (face, hands, forearms, lower legs and feet)			
			4427				0.00E+00
			5653	[1], adult, aged 15 to 31 years (face, hands, forearms, lower legs and feet)			0.00E+00
Mass of soil adhered to the unit surface area of skin exposed	AF	mg/sq. cm.		[1], child, aged 1-8 years (face, hands, forearms, lower legs and feet)			
			0.35	[2], child, aged 1-8 years	3.50E-01	child, aged 1 to 2 years	3.50E-01
			0.13	[2], adult, aged 15-31 years			0.00E+00
			0.14	[2], older child, aged 8-15 years			0.00E+00
Relative Absorption Factor	RAF	unitless	See RAF Table			See RAF Table	
Exposure frequency: # exposure events during EP / # days in EP	EF	events/year	150	[1] 15 days per week during the 30 warmest weather weeks of the year	78	For 0-3 and 3-6 foot interval soils, exposure presumed to occur three days per week during a six month construction period (F170); and for 6-11 foot interval soils, exposure presumed to occur seven days per week during a six month construction period (J170).	1.82E+02
Exposure duration: typical duration of each exposure event	ED	years/event	2.74E-03	1 day per event or 1/365 of a year per event			2.74E-03
Exposure period: period of time over which exposure may occur	EP	years		[1], child, aged 8 to 15 years			7.00E+00
Unit Conversion Factor	C	kg/mg	1.00E-06				1.00E-06
	C	kg/mg	1.00E-06	for ingestion			1.00E-06
	BW	kg		[1], child, aged 8-15 years			3.99E+01
Body weight of the receptor during the AP			39.9	[1], adult, aged 15 to 31 years			5.87E+01
			58.7	[1], young child, aged 1-8 years	1.0	subchronic exposure of 1 year old boy or girl (Subchronic)	1.00E+00
			17.0	for dermal contact			
Averaging Period	AP	years	70	[1]	1.07E+01	subchronic exposure of 1 year old boy or girl	1.07E+01
Ingestion rate	IR	mg/day	50	[1], age 8 or greater			5.00E+01
			100	[1], age 1-8 years			1.00E+02

References:

- [1] MADEP's Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan, Interim Final Policy BWSC/ORSS-95-141 [Updated using exposure assumptions of MADEP's Method 1 Numerical Standard Development Workbook, 5/2009].
- [2] MADEP's Technical Update, Weighted Skin-Soil Adherence Factors, April 2002.

Table 3.4
Calculation of Lifetime Average Daily Exposure from Inhalation of Dust: Resident, aged 1 to 2 Years (East End of Courtyard: 10/26/2016)

Receptor: Resident, aged 1 to 31 years							
Chemical Name	CAS Number	Weight of Evidence Class	East End of Courtyard: 0-3 Foot Interval	East End of Courtyard: 3-6 Foot Interval	East End of Courtyard: 6-20 Foot Interval		
benzene	71-43-2		2.1E-11	2.5E-11	1.2E-10		
benzo(a)anthracene	36-53-3		1.1E-09	8.9E-10	4.9E-10		
benzo(a)pyrene	50-32-8		1.0E-09	6.8E-10	3.8E-10		
benzo(b)fluoranthene	205-99-2		1.4E-09	8.2E-10	4.7E-10		
benzo(k)fluoranthene	207-08-9		6.0E-10	4.7E-10	2.2E-10		
chlordane	57-74-9		4.0E-11	3.2E-10	3.2E-10		
chrysene	218-01-9		1.3E-09	1.1E-09	5.4E-10		
dibenz(a,h)anthracene	53-70-3		2.2E-10	3.1E-10	1.2E-10		
dieldrin	60-57-1		1.2E-11	6.5E-11	6.5E-11		
dioxin (TCDD equivalents)	1746-01-6		1.0E-14	1.4E-14	1.4E-15		
indeno(1,2,3-cd)pyrene	193-39-5		6.4E-10	5.0E-10	2.4E-10		
polychlorinated biphenyls	1336-36-3		3.2E-09	4.2E-09	4.3E-10		

A = USEPA Known Human Carcinogen

B1 or B2 = USEPA Probable Human Carcinogen

C = USEPA Possible Human Carcinogen

NC or blank space = Not a carcinogen or insufficient information

Formula: Lifetime Average Daily Exposure (LADE) via inhalation (ihl) of dusts							
Unit:							
$\text{LADE-ihl} = \frac{[\text{OHM-dust}] * \text{EF} * \text{ED} * \text{EP} * \text{C}}{\text{AP}}$					LADE, mg/cu m		
Receptor: Resident, aged 1 to 31 years							
Description	Abbreviation	Unit	Default Value	Source	Site-Specific Value	Source / Description	Input Value
Exposure point concentration	[OHM-dust]	ug/cu. m.			See Dust EPC Table		See Dust EPC Table
Exposure frequency: # exposure events during EP / # days in EP	EF	events/year	150	[1] 5 days per week during the 30 warmest weather weeks of the year			0.00E+00
			150	[1] 5 days per week during the 30 warmest weather weeks of the year	182	Seven days per week during a six-month construction project, during age 1-2 years	1.82E+02
Exposure duration: typical duration of each exposure event	ED	years/event	2.74E-03	1 day per event or 1/365 of a year			2.74E-03
Exposure period: period of time over which exposure may occur	EP	years	23	[1], from age 8 to 31 years			2.30E+01
			7	[1], from age 1 to 8 years	1.00E+00	Presume exposure occurs during a construction project from age 1 to 2 years of age, to either a girl or boy.	1.00E+00
Unit Conversion Factor	C	mg/ug	1.00E-03	for inhalation			1.00E-03
Averaging Period	AP	years	70	[1]			7.00E+01

References:

- [1] MADEP's Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan, Interim Final Policy BWSC/ORS-95-141

Table 4.2
Calculation of Excess Lifetime Cancer Risk (ELCR) for Exposure to Soil and Dust: Resident, aged 1 to 2 Years (East End of Courtyard: 10/26/2016)

Receptor: Resident, aged 1 to 31 years																				
			Exposure Point: East End of Courtyard: 0-3 Foot Interval			East End of Courtyard: 3-6 Foot Interval			East End of Courtyard: 6-20 Foot Interval			0.00E+00			0.00E+00					
Chemical Name	CAS Number	Weight of Evidence Class	Dermal Contact	Incidental Ingestion	Dust Inhalation	Dermal Contact	Incidental Ingestion	Dust Inhalation	Dermal Contact	Incidental Ingestion	Dust Inhalation	Dermal Contact	Incidental Ingestion	Dust Inhalation	Dermal Contact	Incidental Ingestion	Dust Inhalation			
benzene	71-43-2		1.3E-11	2.6E-10	1.6E-13	1.6E-11	3.1E-10	1.9E-13	1.7E-10	3.4E-09	9.0E-13									
benzo(a)anthracene	36-53-3		6.3E-09	3.5E-08	2.3E-10	3.1E-09	4.4E-08	1.0E-10	6.5E-09	3.6E-08	1.0E-10									
benzo(a)pyrene	50-32-8		5.7E-08	5.0E-07	2.1E-09	3.9E-08	3.4E-07	1.4E-09	5.0E-08	4.3E-07	7.8E-10									
benzo(b)fluoranthene	205-99-2		7.9E-09	6.9E-08	2.9E-10	4.7E-09	4.1E-08	1.7E-10	6.2E-09	8.4E-08	9.7E-11									
benzo(k)fluoranthene	207-08-9		3.4E-10	3.0E-09	1.2E-11	4.1E-10	2.3E-09	9.7E-12	3.0E-10	1.6E-09	4.7E-12									
chlor dane	57-74-9		2.7E-10	3.2E-09	4.0E-12	2.2E-09	2.6E-08	3.2E-11	5.1E-09	6.0E-08	3.2E-11									
chrysene	218-01-9		7.4E-10	6.4E-09	2.7E-11	6.2E-10	5.4E-09	2.3E-11	7.2E-10	6.3E-09	1.1E-11									
dibenzo(a,h)anthracene	53-70-3		1.3E-08	1.1E-07	4.7E-10	1.8E-08	1.5E-07	6.5E-10	1.6E-08	1.4E-07	2.5E-10									
dieldrin	60-57-1		7.7E-09	4.5E-08	5.7E-11	4.0E-08	2.3E-07	3.0E-10	9.4E-08	5.5E-07	3.0E-10									
dioxin (TCDD equivalents)	1746-01-6		6.1E-08	3.5E-07	3.4E-10	8.1E-08	4.7E-07	4.6E-10	1.9E-08	1.1E-07	4.6E-11									
indeno[1,2,3-cd]pyrene	193-39-5		3.7E-09	3.2E-08	1.3E-10	2.8E-09	2.5E-08	1.0E-10	3.3E-09	2.8E-08	5.1E-11									
polychlorinated biphenyls	1336-36-3		2.5E-07	1.4E-06	3.2E-10	3.3E-07	1.9E-06	4.2E-10	7.8E-08	4.5E-07	4.3E-11									
Total ELCR: Route and Expos. Pt.			4.0E-07	2.6E-06	4.0E-09	5.2E-07	3.2E-06	3.8E-09	2.8E-07	1.9E-06	1.7E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
Proportion of complete exposure point			1.0E+00			1.0E+00				1.0E+00		1.0E+00			1.0E+00					
Adjusted Total ELCR: Route and Expos. Pt.			4.0E-07	2.6E-06	4.0E-09	5.2E-07	3.2E-06	3.8E-09	2.8E-07	1.9E-06	1.7E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
Total ELCR: Expos. Pt.				3.0E-06			3.8E-06			2.2E-06			0.0E+00			0.0E+00				

Formula:

$$\text{Cumulative ELCR} = \sum ELCR_{\text{ingestion - chemicalspecific}} + \sum ELCR_{\text{dermalcontact - chemicalspecific}} + \sum ELCR_{\text{inhalation: chemical - specific}}$$

ELCR ingestion-chemical specific = LADD-ingestion-chemical specific x Oral Slope Factor-chemical specific
 ELCR dermal contact-chemical specific = LADD-dermal contact-chemical specific x Oral Slope Factor-chemical specific
 ELCR ingestion-chemical specific = LADE-ingestion-chemical specific x Unit Risk-ingestion-chemical specific

ELCR = Excess Lifetime Cancer Risk, unit less
 LADD = Lifetime Average Daily Dose, mg/kg/day
 LADE = Lifetime Average Daily Exposure, mg/cu m

Table 5.2
Calculation of Total Excess Lifetime Cancer Risk (ELCR): Resident, aged 1 to 2 Years (East End of Courtyard: 10/26/2016)

Receptor Exposure Point #	Resident							Youth Trespasser or Visitor						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pathway:														
Soil Exposure Point:														
Incidental ingestion of soil, normal	2.6E-06	3.2E-06	1.9E-06											
Inhalation of dusts from disturbed soil	4.0E-09	3.8E-09	1.7E-09											
Dermal contact with soil	4.0E-07	5.2E-07	2.8E-07											
Total ELCR	3.0E-06	3.8E-06	2.2E-06											
MCP Cancer Risk Limit	1.E-05	1.E-05	1.E-05											
Does Total ELCR exceed MCP Cancer Risk Limit?	No	No	No											
Significant Risk of Harm?	No	No	No											

Definition of exposure points	Resident						
Exposure Point #	1	2	3	4	5	6	7
Soil Exposure Point:	East End of Courtyard: 0-3 Foot Interval	East End of Courtyard: 3-6 Foot Interval	East End of Courtyard: 6-20 Foot Interval	0.00E+00	0.00E+00		

NO SINGLE FAMILY RESIDENCE. NO GARDENING OF EDIBLE PRODUCE.

EXPOSURE TO SOILS OCCURS ONLY DURING A SINGLE SIX-MONTH CONSTRUCTION PROJECT, AFTER WHICH TIME THE SOILS ARE RETURNED TO EXCAVATION OR ARE TRANSPORTED OFF-SITE.

FOR 0-3 AND 3-6 FOOT INTERVAL SOILS, ASSUMES CONTROLS ARE USED TO LIMIT RESIDENTIAL EXPOSURE TO SOILS DURING CONSTRUCTION PROJECT.

PROTECTIVE COVER MUST REMAIN OVER SOILS EXCEPT DURING CONSTRUCTION OR UTILITY PROJECT, AFTER WHICH TIME THE PROTECTIVE COVER MUST BE RE-INSTALLED.

Table 2.1
Nonscancer Dose-Response Values:
Oral Reference Dose

Chemical Name	CAS Number	Subchronic Oral RfD (mg/kg/day)	Uncertainty/Modifying Factors	Source	Date Last Checked	Chronic Oral RfD (mg/kg/day)	Uncertainty/Modifying Factors	Source	Date Last Checked
acenaphthene	83-32-9	2.0E-01		MADEP (6)		6.0E-02		MADEP (6)	
acenaphthylene	208-96-8	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
anthracene	120-12-7	1.0E+00		MADEP (6)		3.0E-01		MADEP (6)	
barium	7440-39-3	7.0E-02		MADEP (6)		2.0E-01		MADEP (6)	
benzene	71-43-2	1.0E-02		MADEP (6)		4.0E-03		MADEP (6)	
benzo(a)anthracene	56-55-3	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
benzo(a)pyrene	50-32-8	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
benzo(b)fluoranthene	205-99-2	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
benzo(k)fluoranthene	207-08-9	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
benzo(ghi)perylene	191-24-2	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
beryllium	7440-41-7	5.0E-03		MADEP (6)		2.0E-03		MADEP (6)	
cadmium	7440-43-9	5.0E-04		MADEP (6)		5.0E-04		MADEP (6)	
chlorodane	57-74-9	5.0E-04		MADEP (6)		2.0E-03		MADEP (6)	
chromium (III)	16065-83-1	1.5E+00		MADEP (6)		1.5E+00		MADEP (6)	
chrysene	218-01-9	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
dibenzo(a,h)anthracene	53-70-3	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
DDE	72-55-9	5.0E-04		MADEP (6)		5.0E-04		MADEP (6)	
DDT	50-29-3	5.0E-04		MADEP (6)		5.0E-04		MADEP (6)	
diethyltin	60-57-1	5.0E-05		MADEP (6)		5.0E-05		MADEP (6)	
dioxin (TCDD equivalents)	1746-01-6	7.0E-10		MADEP (6)		7.0E-10		MADEP (6)	
fluoranthene	206-44-0	4.0E-01		MADEP (6)		4.0E-02		MADEP (6)	
fluorene	86-73-7	4.0E-01		MADEP (6)		4.0E-02		MADEP (6)	
indeno(1,2,3-cd)pyrene	193-39-5	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
lead	7439-92-1	7.5E-04		MADEP (6)		7.5E-04		MADEP (6)	
mercury (from mercuric chloride)	7439-97-6	3.0E-04		MADEP (6)	02/13	3.0E-04		MADEP (6)	02/13
2-methylnaphthalene	91-57-6	4.0E-03		MADEP (6)		4.0E-03		MADEP (6)	
naphthalene	91-20-3	2.0E-01		MADEP (6)		2.0E-02		MADEP (6)	
nickel (soluble salts)	7440-02-0	2.0E-02		MADEP (6)		2.0E-02		MADEP (6)	
phenanthrene	85-01-8	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
polychlorinated biphenyls, as PCB-1254	1336-36-3	5.0E-05		MADEP (6)		2.0E-05		MADEP (6)	
pyrene	129-00-0	3.0E-01		MADEP (6)		3.0E-05		MADEP (6)	
rhodium	7440-28-0	8.0E-04		MADEP (6)		8.0E-05		MADEP (6)	
toluene	108-88-3	8.0E-01		MADEP (6)		8.0E-02		MADEP (6)	
vanadium	7440-62-2	9.0E-03		MADEP (6)		9.0E-03		MADEP (6)	
zinc	7440-66-6	3.0E-01		MADEP (6)		3.0E-01		MADEP (6)	
C9-C18 Aliphatics	N/A	1.0E+00		MADEP (6)		1.0E-01		MADEP (6)	
C19-C36 Aliphatics	N/A	6.0E+00		MADEP (6)		2.0E+00		MADEP (6)	
C9-C10 Aromatics	N/A	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	
C11-C22 Aromatics	N/A	3.0E-01		MADEP (6)		3.0E-02		MADEP (6)	

Notes:

Note 1: For all PAH with no subchronic or chronic RfD, the chronic RfD for naphthalene was used (MADEP(6))

Note 6: Conversion of the inhalation Reference Concentration to an oral Reference Dose, using the equation:

$$RfD = RfC \times \text{Ventilation Rate} / BW = (RfC \times V) / BW = (RfD \times 20 \text{ m}^3/\text{day}) / 70 \text{ kg}$$

MADEP = Massachusetts Department of Environmental Protection

mg/kg/day = milligrams per kilogram body weight per day

N/A = Not available

Reference:

MADEP(6) = Dose response values updated from MADEP's Excel Workbook: Toxicity Values used to derive MCP Method 1 Numerical Standards (6/2014)
(C = SC) = The Chronic Oral RfD was adopted as the Subchronic Oral RfD

Table 2.1
Noncancer Dose-Response Values:
Oral Reference Dose

Chemical Name	CAS Number	Subchronic Oral RfD (mg/kg/day)	Uncertainty/ Modifying Factors	Source	Date Last Checked	Chronic Oral RfD (mg/kg/day)	Uncertainty/ Modifying Factors	Source	Date Last Checked
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Table 2.2
Noncancer Dose-Response Values:
Inhalation Reference Concentrations

Chemical Name	CAS Number	Subchronic Inhalation RfC (mg/cu m)	Uncertainty/ Modifying Factors	Source	Date Last Checked	Chronic Inhalation RfC (mg/cu m)	Uncertainty/ Modifying Factors	Source	Date Last Checked
acenaphthene	83-32-9	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
acenaphthylene	208-96-8	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
anthracene	120-12-7	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
anthracene	7440-39-3	5.0E-03		MADEP(5)		5.0E-04		MADEP(5)	
benzene	71-43-2	1.0E-02		MADEP(5)		1.0E-02		MADEP(5)	
benzo(a)anthracene	56-55-3	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
benzo(a)pyrene	50-32-8	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
benzo(b)fluoranthene	205-99-2	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
benzo(k)fluoranthene	207-08-9	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
benzo(g,h,i)perylene	191-34-2	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
beryllium	7440-41-7	2.0E-05		MADEP(5)		2.0E-05		MADEP(5)	
cadmium	7440-43-9	2.0E-05		MADEP(5)		2.0E-05		MADEP(5)	
chloroane	57-74-9	7.0E-03		MADEP(5)		7.0E-04		MADEP(5)	
chromium (III) (as metal)	16065-83-1	3.0E-04		MADEP(5)		1.0E-04		MADEP(5)	
chrysene	218-01-9	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
dibenz(a,h)anthracene	53-70-3	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
DDE	72-55-9	1.8E-03		MADEP(5)		1.8E-03		MADEP(5)	
DDT	50-29-3	1.8E-03		MADEP(5)		1.8E-03		MADEP(5)	
ieldrin	60-57-1	1.8E-04		MADEP(5)		1.8E-04		MADEP(5)	
dioxin (TCDD equivalents)	1746-01-6			MADEP(5)				MADEP(5)	
fluoranthene	206-44-0	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
fluorene	86-73-7	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
fluoranthene (2,3-d)pyrene	193-39-3	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
lead	7439-92-1	1.0E-03		MADEP(5)		1.0E-03		MADEP(5)	
mercury	7439-97-6	3.0E-04		MADEP(5)	02/13	3.0E-04		MADEP(5)	02/13
naphthalene	91-57-6	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
naphthalene	91-20-3	3.0E-03		MADEP(5)		3.0E-03		MADEP(5)	
nickel	7440-02-0	1.0E-03		MADEP(5)		1.0E-03		MADEP(5)	
phenanthrene	85-01-8	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
polychlorinated biphenyls	1336-36-3	2.0E-05		MADEP(5)		2.0E-05		MADEP(5)	
pyrene	129-00-0	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	
rhodium	7440-28-0	1.4E-05		MADEP(5)		1.4E-05		MADEP(5)	
toluene	108-88-3	5.0E+00		MADEP(5)		5.0E+00		MADEP(5)	
vanadium	7440-62-2	1.0E-03		MADEP(5)		1.0E-03		MADEP(5)	
zinc	7440-66-6	1.4E-03		MADEP(5)		1.4E-03		MADEP(5)	
C9-C18 Aliphatics	N/A	6.0E-01		MADEP(5)		2.0E-01		MADEP(5)	
C19-C36 Aliphatics	N/A	6.0E-01	Note 2			2.0E-01		Note 2	
C9-C10 Aromatics	N/A	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	10/02
C11-C22 Aromatics	N/A	5.0E-01		MADEP(5)		5.0E-02		MADEP(5)	

Notes:

Note 1: For PAHs with no RfCs, the chronic RfC for naphthalene was used as a surrogate

Note 2: For C19-C36 aliphatics, the chronic RfC for C9-C18 aliphatics was used as a surrogate

Note 3: Conversion of the oral Reference Dose to an inhalation Reference Concentration, using the equation:

$$RIC = RfD \times BW / \text{Ventilation Rate} = (RfD \times BW) / V = (RfD \times 70 \text{ kg}) / 20 \text{ m}^3/\text{day}$$

MADEP = Massachusetts Department of Environmental Protection

mg/cu m = milligrams per cubic meter of air

References:

MADEP(5) = Toxicity Spreadsheet and reference page for in excel workbook "Development of MCP Risk-Based Levels for Soil and Groundwater" (6/2014)

(C = SC) = the Chronic Inhalation RfC was adopted as the Subchronic Inhalation RfC

Table 2.3
Relative Absorption Factors: Non-Cancer

Chemical Name	CAS Number	Soil Ingestion RAF	Water Ingestion RAF	Soil Dermal RAF	Water Dermal RAF
acenaphthene	83-32-9	0.3	1	0.1	1
acenaphthylene	208-96-8	0.3	1	0.1	1
anthracene	120-12-7	0.3	1	0.1	1
barium	7440-39-3	1	1	0.1	1
benzene	71-43-2		1	0.03	1
benzo(a)anthracene	56-55-3	0.3	1	0.02	1
benzo(a)pyrene	50-32-8	0.3	1	0.02	1
benzo(b)fluoranthene	205-99-2	0.3		0.02	
benzo(k)fluoranthene	207-08-9	0.3	1	0.02	1
benzo(ghi)perylene	191-24-2	0.3	1	0.1	1
beryllium	7440-41-7			0.1	
cadmium	7440-43-9	0.5	1	0.01	1
chlordanne	57-74-9	1	1	0.04	1
chromium (III)	16065-83-1		1	0.1	1
chrysene	218-01-9	0.3	1	0.02	1
dibenzo(a,h)anthracene	53-70-3	0.3	1	0.02	1
DDD	72-54-8	1	1	0.2	1
DDE	72-55-9	1	1	0.03	1
DDT	50-29-3		1	0.03	1
dieletrin	60-57-1	1	1	0.1	1
dioxin (TCDD equivalent)	1746-01-6	1	1	0.1	1
fluoranthene	206-44-0	0.3	1	0.1	1
fluorene	86-73-7	0.3	1	0.1	1
indeno(1,2,3-cd)pyrene	193-39-3	0.3	1	0.02	1
lead	7439-92-1	0.5	1	0.006	1
mercury	7439-97-6	1	1	0.05	1
2-methylnaphthalene	91-57-6	0.3	1	0.1	1
naphthalene	91-20-3	0.3	1	0.1	1
nickel	7440-02-0		1	0.2	1
phenanthrene	85-01-8	0.3	1	0.1	1
polychlorinated biphenyls	1336-36-3	1	1	0.1	1
pyrene	129-00-0	0.3		0.1	
radium	7440-28-0	1	1	0.01	1
toluene	108-88-3	1	1	0.03	1
vanadium	7440-62-2			0.1	
zinc	7440-66-6	1	1	0.1	1
C9-C18 Aliphatics	N/A	1	1	0.2	1
C19-C36 Aliphatics	N/A	1	1	0.2	1
C9-C10 Aromatics	N/A	1	0.91	0.5	1
C11-C22 Aromatics	N/A	0.3	1	0.1	1

Notes:

References:

(1) A default value of one (1) was assigned to dermal contact with water.

MADEP, 2014. Dose response values updated from MADEP's Excel Workbook: Toxicity Values used to derive MCP Method 1 Numerical Standards (6/2014)

Table 1.1
Soil Exposure Point Concentrations and Soil Concentrations used to Derive Dust Exposure Point
Concentrations (East End of Courtyard: 10/26/2016)

Chemical Name	CAS Number	East End of Courtyard: 0-3 Foot Interval	East End of Courtyard: 3-6 Foot Interval	East End of Courtyard: 6-20 Foot Interval		
acenaphthene	83-32-9	6.24E-01	1.21E+00	3.14E-01		
acenaphthylene	208-96-8	2.17E-01	5.68E-01	2.38E-01		
anthracene	120-12-7	1.24E+00	1.44E+00	1.22E+00		
barium	7440-39-3	3.84E+01	2.70E+01	2.70E+01		
benzene	71-43-2	4.83E-02	5.80E-02	2.70E-01		
benzo(a)anthracene	56-55-3	2.57E+00	2.08E+00	1.14E+00		
benzo(a)pyrene	50-32-8	2.35E+00	1.60E+00	8.78E-01		
benzo(b)fluoranthene	205-99-2	3.26E+00	1.92E+00	1.09E+00		
benzo(k)fluoranthene	207-08-9	1.40E+00	1.09E+00	5.22E-01		
benzo(ghi)perylene	191-24-2	1.30E+00	1.07E+00	5.09E-01		
beryllium	7440-41-7					
chlordane	57-74-9	9.40E-02	7.55E-01	7.55E-01		
chromium (III)	16065-83-1					
chrysene	218-01-9	3.03E+00	2.53E+00	1.27E+00		
dibenz(a,h)anthracene	53-70-3	5.24E-01	7.24E-01	2.83E-01		
DDE	72-55-9					
DDT	50-29-3					
dieldrin	60-57-1	2.90E-02	1.51E-01	1.51E-01		
dioxin (TCDD equivalents)	1746-01-6	2.44E-05	3.23E-05	3.29E-06		
fluoranthene	206-44-0	7.27E+00	5.74E+00	3.38E+00		
fluorene	86-73-7	7.04E-01	2.10E+00	2.31E+00		
inden(1,23-cd)pyrene	193-39-5	1.50E+00	1.17E+00	5.73E-01		
lead	7439-92-1					
mercury (from mercuric chloride)	7439-97-6	3.80E-01	5.60E-02	5.60E-02		
2-methylnaphthalene	91-57-6	1.27E+00	6.62E+00	3.75E+00		
naphthalene	91-20-3	3.52E-01	1.60E+00	1.75E+00		
nickel (soluble salts)	7440-02-0					
phenanthrene	85-01-8	5.86E+00	8.78E+00	4.28E+00		
polychlorinated biphenyls, as PCB-1254	1336-36-3	7.39E+00	9.80E+00	9.97E-01		
pyrene	129-00-0	6.38E+00	8.58E+00	2.50E+00		
thallium	7440-28-0					
toluene	108-88-3	1.71E-01		1.40E-01		
vanadium	7440-62-2	3.89E+01	2.43E+01	2.83E+01		
zinc	7440-66-6					
C9-C18 Aliphatics	N/A	2.34E+02	4.72E+02	6.38E+02		
C19-C36 Aliphatics	N/A	3.77E+02	8.47E+02	1.21E+03		
C9-C10 Aromatics	N/A	4.59E+00	4.95E+00	7.83E+01		
C11-C22 Aromatics	N/A	7.98E+02	1.63E+03	1.80E+03		

unit, milligram per kilogram (mg/kg), ppm

Abbreviations:

Table 1.2
Exposure Point Concentrations for Dust (East End of Courtyard: 10/26/2016)

Chemical Name	CAS Number	East End of Courtyard: 0-3 Foot Interval	East End of Courtyard: 3-6 Foot Interval	East End of Courtyard: 6-20 Foot Interval	0.00	0.00	0.00	0.00
acenaphthene	83-32-9	3.74E-05	7.26E-05	1.88E-05				
acenaphthylene	208-96-8	1.30E-05	3.41E-05	1.43E-05				
anthracene	120-12-7	7.44E-05	8.64E-05	7.32E-05				
barium	7440-39-3	2.30E-03	1.62E-03	1.62E-03				
benzene	71-43-2	2.90E-06	3.48E-06	1.62E-05				
benzo(a)anthracene	56-55-3	1.54E-04	1.25E-04	6.84E-05				
benzo(a)pyrene	50-32-8	1.41E-04	9.60E-05	5.27E-05				
benzo(b)fluoranthene	205-99-2	1.96E-04	1.15E-04	6.54E-05				
benzo(k)fluoranthene	207-08-9	8.40E-05	6.54E-05	3.13E-05				
benzo(ghi)perylene	191-24-2	7.80E-05	6.42E-05	3.05E-05				
beryllium	7440-41-7							
chlordanne	57-74-9	5.64E-06	4.53E-05	4.53E-05				
chromium (III)	16065-83-1							
chrysene	218-01-9	1.82E-04	1.52E-04	7.62E-05				
dibenz(a,h)anthracene	53-70-3	3.14E-05	4.34E-05	1.70E-05				
DDE	72-55-9							
DDT	50-29-3							
dieldrin	60-57-1	1.74E-06	9.06E-06	9.06E-06				
dioxin (TCDD equivalents)	1746-01-6	1.46E-09	1.94E-09	1.97E-10				
fluoranthene	206-44-0	4.36E-04	3.44E-04	2.03E-04				
fluorene	86-73-7	4.22E-05	1.26E-04	1.39E-04				
indeno(123-cd)pyrene	193-39-5	9.00E-05	7.02E-05	3.44E-05				
lead	7439-92-1							
mercury (from mercuric chloride)	7439-97-6	2.28E-05	3.36E-06	3.36E-06				
2-methylnaphthalene	91-57-6	7.62E-05	3.97E-04	2.25E-04				
naphthalene	91-20-3	2.11E-05	9.60E-05	1.05E-04				
nickel (soluble salts)	7440-02-0							
phenanthrene	85-01-8	3.52E-04	5.27E-04	2.57E-04				
polychlorinated biphenyls, as PCB-1254	1336-36-3	4.43E-04	5.88E-04	5.98E-05				
pyrene	129-00-0	3.83E-04	5.15E-04	1.50E-04				
thallium	7440-28-0							
toluene	108-88-3	1.03E-05		8.40E-06				
vanadium	7440-62-2	2.33E-03	1.46E-03	1.70E-03				
zinc	7440-66-6							
C9-C18 Aliphatics	N/A	1.40E-02	2.83E-02	3.83E-02				
C19-C36 Aliphatics	N/A	2.26E-02	5.08E-02	7.27E-02				
C9-C10 Aromatics	N/A	2.75E-04	2.97E-04	4.70E-03				
C11-C22 Aromatics	N/A	4.79E-02	9.77E-02	1.08E-01				

Formula:

$$\text{EPC-air} = [\text{OHM}]_{\text{soil}} * \text{PF} * \text{PM-10} * \text{CF}$$

where,

EPC-air = Exposure Point Concentration (ug/cu m)

[OHM]-soil = soil concentration (mg/kg)

PM-10 = respirable particulate concentration in air (60 ug/cu m)

PF = proportion of respirable particulate concentrations attributable to the site (1.0)

CF = conversion factor (1E-06 kg/ug)

Units:

Soil EPC = mg/kg

Dust EPC = ug/cu m

Refer to Table 6.4 for Soil Concentrations used to derive Dust Exposure Point Concentrations

Table 3.1
Calculation of Average Daily Dose for Soil Exposure: Child Resident, aged 1 Year (East End of Courtyard: 10/26/2016)

Receptor: Child Resident, aged 1 year													
Exposure Point:		East End of Courtyard: 0-3 Foot Interval		East End of Courtyard: 3-6 Foot Interval		East End of Courtyard: 6-20 Foot Interval		0.00E+00		0.00E+00		0.00E+00	
Chemical Name	CAS Number	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion	Dermal Contact	Incidental Ingestion
acenaphthene	83-32-9	7.28E-07	3.74E-07	1.41E-06	7.25E-07	8.55E-07	4.39E-07						
acenaphthylene	208-96-8	2.33E-07	1.30E-07	6.63E-07	3.40E-07	6.48E-07	3.33E-07						
anthracene	120-12-7	1.45E-06	7.43E-07	1.68E-06	8.63E-07	3.32E-06	1.71E-06						
barium	7440-39-3	4.48E-05	7.67E-05	3.15E-05	5.39E-05	7.53E-05	1.26E-04						
benzen	71-43-2	1.69E-08	9.65E-08	2.03E-08	1.16E-07	2.21E-07	1.26E-06						
benzo(a)anthracene	56-55-3	6.00E-07	1.54E-06	4.86E-07	1.25E-06	6.21E-07	1.59E-06						
benzo(a)pyrene	50-32-8	5.49E-07	1.41E-06	3.74E-07	9.59E-07	4.78E-07	1.23E-06						
benzo(b)fluoranthene	205-99-2	7.61E-07	1.95E-06	4.48E-07	1.15E-06	5.94E-07	1.52E-06						
benzo(k)fluoranthene	207-08-9	3.27E-07	8.39E-07	2.54E-07	6.53E-07	2.84E-07	7.30E-07						
benzo(ghi)perylene	191-24-2	1.52E-06	7.79E-07	1.25E-06	6.41E-07	1.39E-07	7.12E-07						
beryllium	7440-41-7												
chlor dane	57-74-9	4.39E-08	1.88E-07	3.53E-07	1.51E-06	8.23E-07	3.52E-06						
chromium (III)	16065-83-1												
chrysene	218-01-9	7.07E-07	1.82E-06	5.91E-07	1.52E-06	6.92E-07	1.78E-06						
dibenzo(a,h)anthracene	53-70-3	1.22E-07	3.14E-07	1.69E-07	4.34E-07	1.34E-07	3.96E-07						
DDT	72-55-9												
DDT	50-39-3												
dieldrin	60-57-1	3.39E-08	5.79E-08	1.76E-07	3.02E-07	4.11E-07	7.04E-07						
dioxin (TCDD equivalents)	1746-01-6	2.85E-11	4.87E-11	3.77E-11	6.45E-11	8.96E-12	1.53E-11						
fluoranthene	206-94-0	8.49E-06	4.36E-06	6.70E-06	3.44E-06	9.21E-06	4.73E-06						
fluorene	86-73-7	8.22E-07	4.22E-07	2.45E-06	1.26E-06	6.29E-06	3.23E-06						
indenof(123-cd)pyrene	193-39-5	3.50E-07	8.99E-07	2.73E-07	7.01E-07	3.12E-07	8.01E-07						
lead	7439-92-1												
mercury (from mercuric chloride)	7439-97-6	2.22E-07	7.59E-07	3.27E-08	1.12E-07	7.63E-08	2.61E-07						
2-methylnaphthalene	91-57-6	1.48E-06	7.61E-07	7.73E-06	3.97E-06	1.02E-05	5.24E-06						
naphthalene	91-20-3	4.11E-07	2.11E-07	1.87E-06	9.59E-07	4.77E-06	2.45E-06						
nickel (soluble salts)	7440-02-0												
phenanthrene	85-01-8	6.84E-06	3.51E-06	1.02E-05	5.26E-06	1.17E-05	5.98E-06						
polychlorinated biphenyls, as PCB-1254	1336-36-3	8.63E-06	1.48E-05	1.14E-05	1.96E-05	2.72E-06	4.65E-06						
pyrene	129-90-0	7.45E-06	3.82E-06	1.00E-05	5.14E-06	6.81E-06	3.50E-06						
thallium	7440-28-0												
toluene	108-88-3	5.99E-08	3.42E-07			1.14E-07	6.52E-07						
vanadium	7440-62-2	4.54E-05	7.77E-05	2.84E-05	4.85E-05	7.71E-05	1.32E-04						
zinc	7440-66-6												
C9-C18 Aliphatics	N/A	5.46E-04	4.67E-04	1.10E-03	9.43E-04	3.48E-03	2.97E-03						
C19-C36 Aliphatics	N/A	8.80E-04	7.53E-04	1.98E-03	1.69E-03	6.60E-03	5.64E-03						
C9-C10 Aromatics	N/A	2.68E-05	9.17E-06	2.89E-05	9.89E-06	1.07E-03	3.65E-04						
C11-C22 Aromatics	N/A	9.32E-04	4.78E-04	1.90E-03	9.75E-04	4.89E-03	2.51E-03						

Table 3.1
Calculation of Average Daily Dose for Soil Exposure: Child Resident, aged 1 Year (East End of Courtyard: 10/26/2016)

Formula: Daily Dose (ADD) for exposure to soils via ingestion (ing) and dermal contact							
ADD-dermal = $\frac{[OHM-soil]*SA*AF*RAF*EF*ED*EP*C}{BW*AP}$				Unit:			
ADD-ing = $\frac{[OHM-soil]*IR*RAF*EF*ED*EP*C}{BW*AP}$						ADD, mg/kg/day	
Receptor: Child Resident, aged 1 to 8 years (Chronic) and aged 1 year (Subchronic)							
Description	Abbreviation	Unit	Default Value	Source	Site-Specific Value	Source / Description	Input Value
Exposure point concentration	[OHM-soil]	mg/kg			See Soil EPC Table		See Soil EPC Table
Skin surface area in contact with soil on days exposed	SA	square centimeter/day	2431	[2], child, aged 1 to 8 years (face, hands, forearms, lower legs and feet)	1670	child, aged 1 to 2 years (face, hands, forearms, lower legs and feet)	1.67E+03
Mass of soil adhered to the unit surface area of skin exposed	AF	mg/sq. cm.	0.35	[1], for child resident			3.50E-01
Relative Absorption Factor	RAF	unitless	See RAF Table				See RAF Table
# exposure events during EP / # days in EP	EF	events/year	150	[2], 5 days per week during the 30 warmest weeks of the year	78	Three days per week during a six-month construction project for 0-3 and 3-6 foot interval soils (F166); and seven days per week during six-month construction project for 6-11 foot interval soils (J166).	1.82E+02
Exposure duration: typical duration of each exposure event	ED	years/event	2.74E-03	1 day per event or 1/365 of a year per event			2.74E-03
Exposure period: period of time over which exposure may occur	EP	years	7	[2], child, aged 1 to 8 years	1.0	subchronic exposure of 1 year old boy or girl (Subchronic)	1.00E+00
Unit Conversion Factor	C	kg/mg	1.00E-06	for dermal contact			1.00E-06
Unit Conversion Factor	C	kg/mg	1.00E-06	for ingestion			1.00E-06
Body weight of the receptor during the AP	BW	kg	17	[2], child, aged 1 to 8 years	1.07E+01	subchronic exposure of 1 year old boy or girl	1.07E+01
Averaging Period	AP	years	7	[2]	1.0	subchronic exposure of 1 year old boy or girl	1.00E+00
Ingestion rate	IR	mg/day	100	[2]			1.00E+02

References:

- [1] MADEP's Technical Update, Weighted Skin-Soil Adherence Factors, April 2002.
- [2] MADEP's Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan, Interim Final Policy BWSC/ORS-95-141

Table 3.2
Calculation of Average Daily Exposure for Dust: Child Resident, aged 1 (East End of Courtyard: 10/26/2016)

Receptor: Child Resident, aged 1 year					
Chemical Name	CAS Number	East End of Courtyard: 0-3 Foot Interval	East End of Courtyard: 3-6 Foot Interval	East End of Courtyard: 6-20 Foot Interval	
acenaphthene	83-32-9	1.9E-08	3.6E-08	9.4E-09	
acenaphthylene	208-96-8	6.5E-09	1.7E-08	7.1E-09	
anthracene	120-12-7	3.7E-08	4.3E-08	3.6E-08	
barium	7440-39-3	1.1E-06	8.1E-07	8.1E-07	
benzene	71-43-2	1.4E-09	1.7E-09	8.1E-09	
benzo(a)anthracene	56-55-3	7.7E-08	6.2E-08	3.4E-08	
benzo(a)pyrene	50-32-8	7.0E-08	4.8E-08	2.6E-08	
benzo(b)fluoranthene	205-99-2	9.8E-08	5.7E-08	3.3E-08	
benzo(k)fluoranthene	207-08-9	4.2E-08	3.3E-08	1.6E-08	
benzo(ghi)perylene	191-24-2	3.9E-08	3.2E-08	1.5E-08	
beryllium	7440-41-7				
chlordane	57-74-9	2.8E-09	2.3E-08	2.3E-08	
chromium (III)	16065-83-1				
chrysene	218-01-9	9.1E-08	7.6E-08	3.8E-08	
dibenz(a,h)anthracene	53-70-3	1.6E-08	2.2E-08	8.5E-09	
DDE	72-55-9				
DDT	50-29-3				
ieldrin	60-57-1	8.7E-10	4.5E-09	4.5E-09	
dioxin (TCDD equivalents)	1746-01-6	7.3E-13	9.7E-13	9.8E-14	
fluoranthene	206-44-0	2.2E-07	1.7E-07	1.0E-07	
fluorene	86-73-7	2.1E-08	6.3E-08	6.9E-08	
indeno(1,2,3-cd)pyrene	193-39-5	4.5E-08	3.5E-08	1.7E-08	
lead	7439-92-1				
mercury (from mercuric chloride)	7439-97-6	1.1E-08	1.7E-09	1.7E-09	
2-methylnaphthalene	91-57-6	3.8E-08	2.0E-07	1.1E-07	
naphthalene	91-20-3	1.1E-08	4.8E-08	5.2E-08	
nickel (soluble salts)	7440-02-0				
phenanthrene	85-01-8	1.8E-07	2.6E-07	1.3E-07	
polychlorinated biphenyls, as PCB-1254	1336-36-3	2.2E-07	2.9E-07	3.0E-08	
pyrene	129-00-0	1.9E-07	2.6E-07	7.5E-08	
thallium	7440-28-0				
toluene	108-88-3	5.1E-09		4.2E-09	
vanadium	7440-62-2	1.2E-06	7.3E-07	8.5E-07	
zinc	7440-66-6				
C9-C18 Aliphatics	N/A	7.0E-06	1.4E-05	1.9E-05	
C19-C36 Aliphatics	N/A	1.1E-05	2.5E-05	3.6E-05	
C9-C10 Aromatics	N/A	1.4E-07	1.5E-07	2.3E-06	
C11-C22 Aromatics	N/A	2.4E-05	4.9E-05	5.4E-05	

Table 3.2
Calculation of Average Daily Exposure for Dust: Child Resident, aged 1 (East End of Courtyard: 10/26/2016)

Formula: Average Daily Exposure (ADE) via inhalation (ihl) of dusts							
						Unit:	
$\text{ADE-ihl} = \frac{[\text{OHM-dust}] * \text{EF} * \text{ED} * \text{EP} * \text{C}}{\text{AP}}$						ADE, mg/cu m	
Receptor: Child Resident, aged 1 to 8 years (Chronic) and aged 1 year (Subchronic)							
Description	Abbreviation	Unit	Default Value	Source	Site-Specific Value	Source / Description	Input Value
Exposure point concentration	[OHM-dust]	ug/cu. m.			See Dust EPC Table		See Dust EPC Table
Exposure frequency: # exposure events during EP / # days in EP	EF	events/year	150	[2], 5 days per week during the 30 warmest weeks of the year	182	Seven days per week during a six-month construction project	1.82E+02
Exposure duration: typical duration of each exposure event	ED	years/event	2.74E-03	1 day per event, or 1/365 of a year per event			2.74E-03
Exposure period: period of time over which exposure may occur	EP	years	7	[1], from age 1 to 8 years	1.00E+00	subchronic exposure of 1 year old boy or girl	1.00E+00
Unit Conversion Factor	C	mg/ug	1.00E-03	for inhalation			1.00E-03
Averaging Period	AP	years	7	[1]	1.00E+00	subchronic exposure of 1 year old boy or girl	1.00E+00

References:

- [1] MADEP's Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan, Interim Final Policy BWSC/ORS-95-141

Table 4.1
Calculation of Hazard Index (HI) for Exposure to Soil and Dust: Child Resident, aged 1 Year (East End of Courtard: 10/26/2016)

Receptor: Child Resident, aged 1 year																
Exposure Point:		East End of Courtard: 0-3 Foot Interval			East End of Courtard: 3-6 Foot Interval			East End of Courtard: 6-20 Foot Interval			0.0E+00			0.0E+00		
Chemical Name	CAS Number	Dermal Contact	Incidental Ingestion	Dust Inhalation	Dermal Contact	Incidental Ingestion	Dust Inhalation	Dermal Contact	Incidental Ingestion	Dust Inhalation	Dermal Contact	Incidental Ingestion	Dust Inhalation	Dermal Contct	Incidental Ingestion	Dust Inhalation
acenaphthene	83-32-9	3.6E-06	1.9E-06	3.7E-08	7.1E-06	3.6E-06	7.2E-08	4.3E-06	2.2E-06	1.9E-08						
acenaphthylene	208-96-8	8.4E-07	4.3E-07	1.3E-08	2.2E-06	1.1E-06	3.4E-08	2.2E-06	1.1E-06	1.4E-08						
anthracene	120-12-7	1.4E-06	7.4E-07	7.4E-08	1.7E-06	8.6E-07	8.6E-08	3.3E-06	1.7E-06	7.3E-08						
barium	7440-39-3	6.4E-04	1.1E-03	2.3E-04	4.5E-04	7.7E-04	1.6E-04	1.1E-03	1.8E-03	1.6E-04						
benzene	71-43-2	1.7E-06	9.0E-06	1.4E-07	2.0E-06	1.3E-05	1.7E-07	3.3E-05	1.3E-04	8.1E-07						
benzo(a)anthracene	56-53-5	2.0E-06	5.1E-06	1.5E-07	1.6E-06	4.2E-06	1.2E-07	2.1E-06	5.3E-06	6.8E-08						
benzo(a)pyrene	50-32-8	1.8E-06	4.7E-06	1.4E-07	1.2E-06	3.2E-06	9.6E-08	1.6E-06	4.1E-06	5.3E-08						
benzo(b)fluoranthene	205-99-2	2.5E-06	6.5E-06	2.0E-07	1.5E-06	3.8E-06	1.1E-07	2.0E-06	5.1E-06	6.5E-08						
benzo(k)fluoranthene	207-08-9	1.1E-06	2.8E-06	8.4E-08	8.5E-07	2.2E-06	6.3E-08	9.3E-07	2.4E-06	3.1E-08						
benzene	131-34-2	5.1E-06	2.6E-06	7.8E-08	4.2E-06	2.1E-06	6.4E-08	4.6E-06	2.4E-06	3.0E-08						
beryllium	440-22-7															
chlor dane	57-74-9	8.8E-05	3.8E-04	4.0E-07	7.1E-04	3.0E-03	3.2E-06	1.6E-03	7.0E-03	3.2E-06						
chromium (III)	16065-83-1															
chrysene	218-01-9	2.4E-06	6.1E-06	1.8E-07	2.0E-06	5.1E-06	1.5E-07	2.3E-06	5.9E-06	7.6E-08						
dibenz(a,h)anthracene	53-70-3	4.1E-07	1.0E-06	3.1E-08	5.6E-07	1.4E-06	4.3E-08	5.1E-07	1.3E-06	1.7E-08						
DDT	72-85-5															
DDT	50-29-3															
dieldrin	60-57-1	6.8E-04	1.2E-03	5.0E-06	3.5E-03	6.0E-03	2.6E-05	8.2E-03	1.4E-02	2.6E-05						
dioxin (TCDD equivalents)	1746-01-6	4.1E-02	7.0E-02	5.4E-02	9.2E-02	1.3E-02	2.2E-02									
fluoranthene	206-44-0	3.1E-05	1.1E-05	4.4E-07	1.7E-05	3.6E-06	3.4E-07	2.3E-05	1.3E-05	2.0E-07						
fluorene	86-73-7	2.1E-06	1.1E-06	4.2E-08	6.1E-06	8.1E-06	1.3E-07	1.6E-05	8.1E-06	1.4E-07						
indeno[1,2,3-cd]pyrene	193-39-5	1.2E-06	3.0E-06	9.0E-08	9.1E-07	2.3E-06	7.0E-08	1.0E-06	2.7E-06	3.4E-08						
lead	7439-92-1															
mercury (from mercury chloride)	7439-97-6	7.4E-04	2.5E-03	3.8E-05	1.1E-04	3.7E-04	5.6E-06	2.5E-04	8.7E-04	5.6E-06						
naphthalene	91-20-3	3.7E-04	1.0E-04	2.6E-08	1.0E-03	9.9E-04	4.10E-07	3.0E-03	1.31E-03	3.3E-07						
naphthalene	91-20-3	2.1E-06	1.1E-06	3.5E-06	9.3E-06	4.8E-06	1.6E-05	2.4E-05	1.2E-05	1.7E-05						
nickel (soluble salts)	7440-02-0															
phenanthrene	85-01-8	2.3E-05	1.2E-05	3.5E-07	3.4E-05	1.8E-05	5.3E-07	3.9E-05	2.0E-05	2.6E-07						
polychlorinated biphenyls; as PCB-1254	1336-36-3	1.7E-01	3.0E-01	1.1E-02	2.3E-01	3.9E-01	1.5E-02	5.4E-02	9.3E-02	1.5E-03						
pyrene	128-00-0	2.5E-05	1.3E-05	3.8E-07	3.3E-05	7.7E-05	5.1E-07	2.3E-05	1.2E-05	1.5E-07						
thallium	7440-28-0															
toluene	108-88-3	7.5E-08	4.3E-08	1.0E-09	1.0E-07	1.0E-07	1.4E-07	8.2E-07	8.4E-10							
vanadum	7440-62-2	5.0E-03	8.6E-03	1.2E-03	3.2E-03	5.4E-03	7.3E-04	8.6E-03	1.5E-02	8.5E-04						
zinc	7440-66-6															
C9-C18 Aliphatics	N/A	5.5E-04	4.7E-04	1.2E-05	1.1E-03	9.4E-04	2.4E-05	3.5E-03	3.0E-03	3.3E-05						
C9-C36 Aliphatics	N/A	1.5E-04	1.3E-04	1.9E-05	3.3E-04	2.8E-04	4.2E-05	1.1E-03	9.4E-04	6.0E-05						
C9-C10 Aromatics	N/A	8.9E-05	3.1E-05	2.7E-07	9.6E-05	3.3E-05	3.0E-07	3.6E-03	1.2E-03	4.7E-06						
C11-C22 Aromatics	N/A	3.1E-03	1.6E-03	4.8E-05	6.3E-03	3.3E-03	9.7E-05	1.6E-02	8.4E-03	1.1E-04						
Total HI: Route and Expos. Pt.		2.2E-01	3.8E-01	1.3E-02	3.0E-01	5.0E-01	1.6E-02	1.1E-01	1.7E-01	2.8E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Proportion of complete exposure point			1.0E+00			1.0E+00			1.0E+00		1.0E+00			1.0E+00		
Adjusted Total HI: Route and Expos. Pt.		2.2E-01	3.8E-01	1.3E-02	3.0E-01	5.0E-01	1.6E-02	1.1E-01	1.7E-01	2.8E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Total HI: Expos. Pt.			6.2E-01			8.2E-01			2.9E-01		0.0E+00			0.0E+00		

Formula:

$$\text{Cumulative HI} = \sum H_{\text{Ingestion - chemical specific}} + \sum H_{\text{dermal contact - chemical specific}} + \sum H_{\text{inhalation: chemical - specific}}$$

HI ingestion-chemical specific = ADD-ingestion-chemical specific x Oral Slope Factor-chemical specific

HI dermal contact-chemical specific = ADD-dermal contact-chemical specific x Oral Slope Factor-chemical specific

HI inhalation-chemical specific = ADE-inhalation-chemical specific x Unit Risk-inhalation-chemical specific

HI = Hazard Index, unitless

ADD = Average Daily Dose, mg/kg/day

ADE = Average Daily Exposure, mg/cu m

Subchronic Oral Reference Dose	X	Use capital X to indicate selection
Chronic Oral Reference Dose		
Subchronic Inhalation Reference Concentration	X	
Chronic Inhalation Reference Concentration		

Table 5.1
Calculation of Total Hazard Index (HI): Child Resident, aged 1 Year (East End of Courtyard: 10/26/2016)

Receptor Exposure Point #	Child Resident, aged 1 year							Child Resident, aged 1-8 years						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Pathway: Soil Exposure Point: Incidental ingestion of soil, normal Inhalation of dusts from disturbed soil Dermal contact with soil	3.8E-01 1.3E-02 2.2E-01	5.0E-01 1.6E-02 3.0E-01	1.7E-01 2.8E-03 1.1E-01											
Total HI	6.2E-01 Subchronic	8.2E-01 Subchronic	2.9E-01 Subchronic											
MCP Non-Cancer Risk Limit Does Total HI exceed MCP Non-Cancer Risk Limit? Significant Risk of Harm?	1.E+00 No No	1.E+00 No No	1.E+00 No No	1.E+00 No No	1.E+00 No No									

Definition of exposure points							
Exposure Point #	1	2	3	4	5	6	7
Soil Exposure Point:	East End of Courtyard: 0-3 Foot Interval	East End of Courtyard: 3-6 Foot Interval	East End of Courtyard: 6-20 Foot Interval				

NO SINGLE FAMILY RESIDENCE. NO GARDENING OF EDIBLE PRODUCE.

EXPOSURE TO SOILS OCCURS ONLY DURING A SINGLE SIX-MONTH CONSTRUCTION PROJECT, AFTER WHICH TIME THE SOILS ARE RETURNED TO EXCAVATION OR ARE TRANSPORTED OFF-SITE.

ASSUMES CONTROLS ARE USED TO LIMIT RESIDENTIAL EXPOSURE TO SOILS DURING CONSTRUCTION PROJECT FOR 0-3 AND 3-6 FOOT INTERVAL SOILS.

ASSUMES NO CONTROLS ARE USED TO LIMIT RESIDENTIAL EXPOSURE TO SOILS DURING CONSTRUCTION PROJECT FOR 6-11 FOOT INTERVAL SOILS.

PROTECTIVE COVER MUST REMAIN OVER SOILS EXCEPT DURING CONSTRUCTION OR UTILITY PROJECT, AFTER WHICH TIME THE PROTECTIVE COVER MUST BE RE-INSTALLED.

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	MassDEP Published Background		SAMPLES NOT REPRESENTATIVE OF EASTERN PORTION OF COURTYARD												
	Natural Soils	Soils assoc. Fill	B-5 (0-1')	B-5 (1-3')	B-5 (0-3')	B-7 (0-1')	B-7 (1-3')	B-7 (0-3')	FO-1-TP (0-1')	FO-1-TP (1-2')	FO-1-TP (2-3')	B-8 (0-1')	SP-1	FO-1 (3')	SP-3
Sampling Date			3/14/2016	3/14/2016	3/14/2016	3/14/2016	3/14/2016	3/14/2016	3/9/2016	3/9/2016	3/9/2016	3/14/2016	2/29/2016	3/9/2016	3/29/2016
Sample Depth During Investigative Event			0-1 Feet	1-3 Feet	0-3 Feet	0-1 Feet	1-3 Feet	0-3 Feet	0-1 Feet (below grade / above vault)	1-2 Feet (below grade / above vault)	2-3 Feet (below grade / above vault)	0-1 Feet	Stockpile / Top Soils	3.5 Feet (just in vault)	Stockpile / Sands in vault
Sample Depth Relative to October 1, 2016			Excavated and Stockpiled	Excavated and Stockpiled	Excavated and Stockpiled	Excavated and Stockpiled	Excavated and Stockpiled	Excavated and Stockpiled	Excavated and Stockpiled	Excavated and Stockpiled	Excavated and Stockpiled	Excavated and Stockpiled	Stockpile / Transported Off-Site	0.5 Feet (just in vault)	Stockpile / Sands in vault
NOTES:			11	11	11	11	11	10,11				11	7	8	9
MADEP-EPH-04-1.1 (mg/Kg dry)															
C9-C18 ALIPHATICS			NT	NT	24	NT	NT	61	NT	NT	NT	NT	ND (10)	NT	
C19-C36 ALIPHATICS			NT	NT	160	NT	NT	140	NT	NT	NT	NT	ND (10)	NT	
C11-C22 AROMATICS			NT	NT	310	NT	NT	180	NT	NT	NT	NT	ND (10)	NT	
ACENAPHTHENE	0.5	2	NT	NT	1.4	NT	NT	2.6	NT	NT	NT	NT	2.4	ND (0.10)	0.70
ACENAPHTHYLENE	0.5	1	NT	NT	0.37	NT	NT	0.38	NT	NT	NT	NT	ND (0.85)	ND (0.10)	ND (0.18)
ANTHRACENE	1	4	NT	NT	3.4	NT	NT	5.4	NT	NT	NT	NT	5.3	ND (0.10)	1.5
BENZO(A)ANTHRACENE	2	9	NT	NT	7.4	NT	NT	11	NT	NT	NT	NT	10	ND (0.10)	3.0
BENZO(A)PYRENE	2	7	NT	NT	6.5	NT	NT	9.3	NT	NT	NT	NT	8.0	ND (0.10)	2.6
BENZO(B)FLUORANTHENE	2	8	NT	NT	9.1	NT	NT	12	NT	NT	NT	NT	9.8	ND (0.10)	3.5
BENZO(G,H,I)PERYLENE	1	3	NT	NT	3.4	NT	NT	5.0	NT	NT	NT	NT	4.5	ND (0.10)	1.4
BENZO(K)FLUORANTHENE	1	4	NT	NT	3.0	NT	NT	4.6	NT	NT	NT	NT	3.9	ND (0.10)	1.4
CHRYSENE	2	7	NT	NT	8.5	NT	NT	12	NT	NT	NT	NT	9.7	ND (0.10)	2.8
DIBENZ(A,H)ANTHRACENE	0.5	1	NT	NT	1.1	NT	NT	1.7	NT	NT	NT	NT	1.4	ND (0.10)	0.59
FLUORANTHENE	4	10	NT	NT	18	NT	NT	26	NT	NT	NT	NT	22	ND (0.10)	7.0
FLUORENE	1	2	NT	NT	1.9	NT	NT	3.4	NT	NT	NT	NT	2.8	ND (0.10)	0.93
INDENO(1,2,3-CD)PYRENE	1	3	NT	NT	4.1	NT	NT	5.1	NT	NT	NT	NT	5.1	ND (0.10)	1.4
2-METHYLNAPHTHALENE	0.5	1	NT	NT	0.67	NT	NT	0.96	NT	NT	NT	NT	0.93	ND (0.10)	0.29
NAPHTHALENE	0.5	1	NT	NT	1.7	NT	NT	1.5	NT	NT	NT	NT	1.6	ND (0.10)	0.59
PHENANTHRENE	3	20	NT	NT	15	NT	NT	23	NT	NT	NT	NT	24	ND (0.10)	5.9
PYRENE	4	20	NT	NT	17	NT	NT	22	NT	NT	NT	NT	23	ND (0.10)	5.0
BIS(2-ETHYLHEXYL)PHTHALATE (see note 7)			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	30	NT	ND (0.36)
DIBENZOFURAN (see notes 7, 9)			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.9	NT	0.37
DI-N-BUTYLPHthalate (see note 7)			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	5.6	NT	ND (0.36)
MADEP-VPH-04-1.1 (mg/Kg dry)															
C5-C8 ALIPHATICS			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (7.9)	ND (8.9)
C9-C12 ALIPHATICS			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (7.9)	ND (8.9)
C9-C10 AROMATICS			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (7.9)	ND (8.9)
BENZENE			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (0.040)	ND (0.044)
ETHYLBENZENE			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (0.040)	ND (0.044)
METHYL TERT-BUTYL ETHER (MTBE)			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (0.040)	ND (0.044)
NAPHTHALENE	0.5	1	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (0.20)	ND (0.22)
TOLUENE			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (0.040)	ND (0.044)
M/P-XYLENE			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (0.079)	ND (0.089)
O-XYLENE			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND (0.040)	ND (0.044)

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	MassDEP Published Background		SAMPLES NOT REPRESENTATIVE OF EASTERN PORTION OF COURTYARD														
	Natural Soils	Soils assoc. Fill	B-5 (0-1')	B-5 (1-3')	B-5 (0-3')	B-7 (0-1')	B-7 (1-3')	B-7 (0-3')	FO-1-TP (0-1')	FO-1-TP (1-2')	FO-1-TP (2-3')	B-8 (0-1')	SP-1	FO-1 (3')	SP-3		
SW-846 6010C/D (mg/Kg dry) Metals Digestion																	
ANTIMONY	1	7	NT	NT	ND (2.7)	NT	NT	ND (2.8)	3.0	ND (2.9)	ND (2.9)	NT	ND (3.1)	ND (2.6)	ND (2.4)		
ARSENIC	20	20	NT	NT	11	NT	NT	13	19	14	18	NT	23	15	8.8		
BARIUM	50	50	NT	NT	120	NT	NT	91	140	95	130	NT	800	32	50		
BERYLLIUM	0.4	0.9	NT	NT	1.4	NT	NT	1.3	0.68	0.39	1.9	NT	14	0.63	0.73		
CADMIUM	2	3	NT	NT	0.89	NT	NT	1.2	1.4	0.98	1.3	NT	3.9	0.51	0.44		
CHROMIUM (as +3)	30	40	NT	NT	34	NT	NT	50	36	31	37	NT	160	25	30		
LEAD	100	600	NT	NT	100	NT	NT	150	340	1100	220	NT	2400	7	25		
NICKEL	20	30	NT	NT	29	NT	NT	26	32	22	29	NT	240	20	18		
SELENIUM	0.5	1	NT	NT	ND (5.4)	NT	NT	ND (5.7)	ND (5.7)	ND (5.9)	ND (5.7)	NT	ND (6.2)	ND (5.2)	ND (4.8)		
SILVER	0.6	5	NT	NT	ND (0.54)	NT	NT	ND (0.57)	ND (1.1)	ND (0.59)	ND (0.57)	NT	ND (0.62)	ND (0.52)	ND (0.48)		
THALLIUM	0.6	5	NT	NT	ND (2.7)	NT	NT	ND (2.8)	ND (2.8)	ND (2.9)	ND (2.9)	NT	ND (3.1)	ND (2.6)	9.8		
VANADIUM	30	30	NT	NT	110	NT	NT	66	160	96	140	NT	3500	32	33		
ZINC	100	300	NT	NT	200	NT	NT	260	250	160	190	NT	1100	23	43		
SW-846 7471B (mg/Kg dry) Metals Digestion																	
MERCURY	0.3	1	NT	NT	0.16	NT	NT	0.38	0.68	0.93	0.84	NT	0.43	ND (0.025)	0.050		
SW-846 8082A (mg/Kg dry)																	
PCB 1016			ND (1.1)*	ND (0.56)	NT	ND (1.1)*	ND (1.1)*	NT	ND (2.3)*	ND (2.3)*	ND (1.1)*	ND (6.0)*	ND (12)*	ND (0.10)	ND (0.53)		
PCB 1221			ND (1.1)*	ND (0.56)	NT	ND (1.1)*	ND (1.1)*	NT	ND (2.3)*	ND (2.3)*	ND (1.1)*	ND (6.0)*	ND (12)*	ND (0.10)	ND (0.53)		
PCB 1232			ND (1.1)*	ND (0.56)	NT	ND (1.1)*	ND (1.1)*	NT	ND (2.3)*	ND (2.3)*	ND (1.1)*	ND (6.0)*	ND (12)*	ND (0.10)	ND (0.53)		
PCB 1242			ND (1.1)*	ND (0.56)	NT	ND (1.1)*	ND (1.1)*	NT	ND (2.3)*	ND (2.3)*	ND (1.1)*	ND (6.0)*	ND (12)*	ND (0.10)	ND (0.53)		
PCB 1248			ND (1.1)*	ND (0.56)	NT	ND (1.1)*	ND (1.1)*	NT	ND (2.3)*	ND (2.3)*	ND (1.1)*	ND (6.0)*	ND (12)*	ND (0.10)	ND (0.53)		
PCB 1254				ND (1.1)*	ND (0.56)	NT	ND (1.1)*	ND (1.1)*	NT	ND (2.3)*	ND (2.3)*	ND (1.1)*	ND (6.0)*	ND (12)*	ND (0.10)	ND (0.53)	
PCB 1260				ND (1.1)*	ND (0.56)	NT	ND (1.1)*	ND (1.1)*	NT	ND (2.3)*	ND (2.3)*	ND (1.1)*	ND (6.0)*	ND (12)*	ND (0.10)	ND (0.53)	
PCB 1262				ND (1.1)*	ND (0.56)	NT	ND (1.1)*	ND (1.1)*	NT	ND (2.3)*	ND (2.3)*	ND (1.1)*	ND (6.0)*	ND (12)*	ND (0.10)	ND (0.53)	
PCB 1268				ND (1.1)*	ND (0.56)	NT	ND (1.1)*	ND (1.1)*	NT	ND (2.3)*	ND (2.3)*	ND (1.1)*	ND (6.0)*	ND (12)*	ND (0.10)	ND (0.53)	
TOTAL PCBs					7.0	3.7	NT	8.5	6.0	NT	13	12	7.8	39	63	ND (0.10)	2.6

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	MassDEP Published Background		SAMPLES NOT REPRESENTATIVE OF EASTERN PORTION OF COURTYARD												
	Natural Soils	Soils assoc. Fill	B-5 (0-1')	B-5 (1-3')	B-5 (0-3')	B-7 (0-1')	B-7 (1-3')	B-7 (0-3')	FO-1-TP (0-1')	FO-1-TP (1-2')	FO-1-TP (2-3')	B-8 (0-1')	SP-1	FO-1 (3')	SP-3
SW-846 8081B (mg/Kg dry)															
ALDRIN			NT	NT	ND (0.12) *	NT	NT	ND (0.12) *	ND (0.11) *	ND (0.12) *	ND (0.11) *	NT	ND (0.12) *	ND (0.0051)	ND (0.0053)
ALPHA-BHC			NT	NT	ND (0.12)	NT	NT	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.11)	NT	ND (0.12)	ND (0.0051)	ND (0.0053)
BETA-BHC			NT	NT	ND (0.12)	NT	NT	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.11)	NT	ND (0.12)	ND (0.0051)	ND (0.0053)
DELTA-BHC			NT	NT	ND (0.12)	NT	NT	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.11)	NT	ND (0.12)	ND (0.0051)	ND (0.0053)
GAMMA-BHC (LINDANE)			NT	NT	ND (0.047) *	NT	NT	ND (0.047) *	ND (0.046) *	ND (0.046) *	ND (0.045) *	NT	ND (0.049) *	ND (0.0021)	ND (0.0021)
CHLORDANE			NT	NT	ND (0.47)	NT	NT	ND (0.47)	ND (0.46)	ND (0.46)	ND (0.45)	NT	ND (0.49)	ND (0.021)	ND (0.021)
4,4'-DDD			NT	NT	ND (0.094)	NT	NT	ND (0.094)	ND (0.092)	ND (0.093)	ND (0.090)	NT	ND (0.099)	ND (0.0041)	ND (0.0042)
4,4'-DDE			NT	NT	ND (0.094)	NT	NT	ND (0.094)	ND (0.092)	0.093	ND (0.090)	NT	ND (0.099)	ND (0.0041)	ND (0.0042)
4,4'-DDT			NT	NT	ND (0.094)	NT	NT	0.11	0.15	0.13	0.13	NT	ND (0.099)	ND (0.0041)	0.019
DIELDRIN			NT	NT	ND (0.094) *	NT	NT	ND (0.094) *	0.16	0.19	0.16	NT	ND (0.099) *	ND (0.0041)	ND (0.0042)
ENDOSULFAN I			NT	NT	ND (0.12)	NT	NT	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.11)	NT	ND (0.12)	ND (0.0051)	ND (0.0053)
ENDOSULFAN II			NT	NT	ND (0.19)	NT	NT	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.18)	NT	ND (0.20)	ND (0.0082)	ND (0.0085)
ENDOSULFAN SULFATE			NT	NT	ND (0.19)	NT	NT	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.18)	NT	ND (0.20)	ND (0.0082)	ND (0.0085)
ENDRIN			NT	NT	ND (0.19)	NT	NT	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.18)	NT	ND (0.20)	ND (0.0082)	ND (0.0085)
ENDRIN KETONE			NT	NT	ND (0.19)	NT	NT	ND (0.19)	ND (0.18)	ND (0.19)	ND (0.18)	NT	ND (0.20)	ND (0.0082)	ND (0.0085)
HEPTACHLOR			NT	NT	ND (0.12)	NT	NT	ND (0.12)	ND (0.11)	ND (0.12)	ND (0.11)	NT	ND (0.12)	ND (0.0051)	ND (0.0053)
HEPTACHLOR EPOXIDE			NT	NT	ND (0.12) *	NT	NT	ND (0.12) *	ND (0.11) *	ND (0.12) *	ND (0.11) *	NT	0.29	ND (0.0051)	ND (0.0053)
HEXAACHLOROBENZENE			NT	NT	ND (0.14)	NT	NT	ND (0.14)	ND (0.14)	ND (0.14)	ND (0.14)	NT	ND (0.15)	ND (0.0062)	ND (0.0064)
METHOXYCHLOR			NT	NT	ND (1.2)	NT	NT	ND (1.2)	ND (1.1)	ND (1.2)	ND (1.1)	NT	ND (1.2)	ND (0.051)	ND (0.053)
SW-846 8151A (mg/kg dry)															
2,4-D			NT	NT	ND (0.029)	NT	NT	ND (0.029)	NT	NT	NT	NT	ND (0.31)	NT	ND (0.026)
2,4-DB			NT	NT	ND (0.029)	NT	NT	ND (0.029)	NT	NT	NT	NT	ND (0.31)	NT	ND (0.026)
2,4,5-TP (SILVEX)			NT	NT	ND (0.0029)	NT	NT	ND (0.0029)	NT	NT	NT	NT	ND (0.031)	NT	ND (0.026)
2,4,5-T			NT	NT	ND (0.0029)	NT	NT	ND (0.0029)	NT	NT	NT	NT	ND (0.031)	NT	ND (0.026)
DALAPON			NT	NT	ND (0.073)	NT	NT	ND (0.073)	NT	NT	NT	NT	ND (0.77)	NT	ND (0.066)
DICAMBA			NT	NT	ND (0.0029)	NT	NT	ND (0.0029)	NT	NT	NT	NT	ND (0.031)	NT	ND (0.0026)
DICHLOROPROP			NT	NT	ND (0.029)	NT	NT	ND (0.029)	NT	NT	NT	NT	ND (0.31)	NT	ND (0.026)
DINOSEB			NT	NT	ND (0.015)	NT	NT	ND (0.015)	NT	NT	NT	NT	ND (0.15)	NT	ND (0.013)
MCPA			NT	NT	ND (2.9)	NT	NT	ND (2.9)	NT	NT	NT	NT	ND (31)	NT	ND (2.6)
MCPP			NT	NT	ND (2.9)	NT	NT	ND (2.9)	NT	NT	NT	NT	ND (31)	NT	ND (2.6)
NOTES:															
1. An asterisk (*) following a detection limit indicates that the minimum laboratory reporting limit exceeds one or more of the regul. criteria.	7. SP-1 is a sample. SP-3 was analyzed for VPH via MADEP's Method and for VOCs via USEPA Method 8260C.														
2. ND = Not detected above the lab reporting limits shown in parenthesis.	These data were collected via USEPA Method 810C. These data include B-7 (03') and B-10 (0-3') were analyzed for PAHs via both MassDEP's Method and USEPA Method 810C.														
3. NT = Not tested.	Soil from B-10 is not included in this table.														
4. ~ = No Method 1 Standard or UCL available	Approved to be used for the analysis of soils from B-10.														
5. Bolded values exceed the Method 1 Cleanup Standards (exclusive of S-x/GW-1).	8. FO-1, FO-2 stockpile soils were placed in the coal chute first, then the remainder of the coal chute was backfilled with excavated soils from east section of courtyard. Soil soils were also placed in dry wells no. 2 to 4, located between B-11 and B-12.														
6. Italic values exceed MassDEP published background conc. for soils assoc. with fill containing coal ash or wood ash.	Detected in approximately 300 to 400 cubic yards of soils are located in the stockpile.														

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS														
	B-1 (15'-20')	B-3 (15'-20')	B-3 (15'-20') (25-28")	B-4 (15'-20')	B-4 (15'-20') (21-24")	B-5 (3-6')	B-5 (6-11')	B-7 (3-6')	B-7 (6-11')	B-8 (1-3')	B-8 (3-6')	B-8 (6-11')	BTM-GT-1	BTM-GT-2	ESW-GT-1
Sampling Date	8/14/2015	8/14/2015	8/14/2015	8/14/2015	8/14/2015	3/14/2016	3/14/2016	3/14/2016	3/14/2016	3/14/2016	3/14/2016	3/14/2016	3/8/2016	3/8/2016	3/8/2016
Sample Depth During Investigative Event	15-20 Feet	15-20 Feet	15-20 Feet	15-20 Feet	15-20 Feet	3-6 Feet	6-11 Feet	3-6 Feet	6-11 Feet	1-3 Feet	3-6 Feet	6-11 Feet	6 Feet	8 Feet	3-4 Feet
Sample Depth Relative to October 1, 2016	12-17 Feet	14-19 Feet	14-19 Feet	12-17 Feet	12-17 Feet	0-3 Feet	3-8 Feet	0-3 Feet	3-8 Feet	0-2 Feet	2-5 Feet	5-10 Feet	3 Feet	5 Feet	0-1 Feet
NOTES:			13		13										
MADEP-EPH-04-1.1 (mg/Kg dry)															
C9-C18 ALIPHATICS	810	48		570		26	300	ND (11)	ND (22)				ND (12)	ND (11)	13
C19-C36 ALIPHATICS	1700	77		1200		64	750	28	48				ND (12)	31	29
C11-C22 AROMATICS	3400	200		3600		220	1400	83	83				25	45	41
ACENAPHTHENE	ND (0.22)	0.22		ND (0.22)		0.76	ND (0.49)	0.54	ND (0.22)				ND (0.12)	ND (0.11)	ND (0.11)
ACENAPHTHYLENE	ND (0.22)	ND (0.11)		ND (0.22)		0.11	ND (0.49)	ND (0.11)	ND (0.22)				ND (0.12)	ND (0.11)	ND (0.11)
ANTHRACENE	1.9	0.65		5.4		1.8	ND (0.49)	1.4	0.29				ND (0.12)	ND (0.11)	ND (0.11)
BENZO(A)ANTHRACENE	3.0	1.1		7.4		4.1	ND (0.49)	2.9	1.2				ND (0.12)	ND (0.11)	ND (0.11)
BENZO(A)PYRENE	ND (0.22)	0.88		5.5		3.7	ND (0.49)	2.4	1.1				0.27	0.11	ND (0.11)
BENZO(B)FLUORANTHENE	ND (0.22)	1.2		7.1		5.3	ND (0.49)	3.3	1.3				0.32	0.15	ND (0.11)
BENZO(G,H,I)PERYLENE	ND (0.22)	0.58		1.5		1.7	ND (0.49)	1.2	0.66				0.38	ND (0.11)	ND (0.11)
BENZO(K)FLUORANTHENE	ND (0.22)	0.43		2.5		2.0	ND (0.49)	1.2	0.52				ND (0.12)	ND (0.11)	ND (0.11)
CHRYSENE	3.8	1.2		7.8		5.0	ND (0.49)	3.2	1.3				0.15	0.11	ND (0.11)
DIBENZ(A,H)ANTHRACENE	ND (0.22)	ND (0.11)		ND (0.22)		0.65	ND (0.49)	0.41	ND (0.22)				ND (0.12)	ND (0.11)	ND (0.11)
FLUORANTHENE	3.5	2.3		15		9.5	1.2	6.6	2.3				0.15	0.17	0.14
FLUORENE	3.5	0.44		6.9		0.90	ND (0.49)	0.78	ND (0.22)				ND (0.12)	ND (0.11)	ND (0.11)
INDENO(1,2,3-CD)PYRENE	ND (0.22)	0.51		2.6		2.1	ND (0.49)	1.3	0.56				0.36	ND (0.11)	ND (0.11)
2-METHYLNAPHTHALENE	0.49	ND (0.11)		3.1		0.29	0.70	0.22	ND (0.22)				ND (0.12)	ND (0.11)	ND (0.11)
NAPHTHALENE	1.3	0.12		2.1		0.44	0.79	0.32	ND (0.22)				ND (0.12)	ND (0.11)	ND (0.11)
PHENANTHRENE	5.3	1.9		21		7.4	1.6	6.1	1.2				0.34	ND (0.11)	0.4
PYRENE	2.6	2.3		13		8.8	ND (0.49)	5.9	2.4				ND (0.12)	0.18	0.13
BIS(2-ETHYLHEXYL)PHTHALATE (see note 7)															
DIBENZOFURAN (see notes 7, 9)															
DI-N-BUTYLPHthalate (see note 7)															
MADEP-VPH-04-1.1 (mg/Kg dry)															
C5-C8 ALIPHATICS	ND (29)	ND (12)		ND (44)									ND (9.6)	ND (9.9)	ND (9.5)
C9-C12 ALIPHATICS	ND (29)	ND (12)		ND (44)									ND (9.6)	ND (9.9)	ND (9.5)
C9-C10 AROMATICS	84	51		100									ND (9.6)	ND (9.9)	ND (9.5)
BENZENE	0.26	ND (0.062)		0.52									0.10	0.058	0.15
ETHYLBENZENE	ND (0.14)	ND (0.062)		ND (0.22)									ND (0.048)	ND (0.050)	ND (0.047)
METHYL TERT-BUTYL ETHER (MTBE)	ND (0.14)	ND (0.062)		ND (0.22)									ND (0.048)	ND (0.050)	ND (0.047)
NAPHTHALENE	ND (0.72)	ND (0.31)		ND (1.1)									ND (0.24)	ND (0.25)	ND (0.24)
TOLUENE	ND (0.14)	ND (0.062)		0.32									0.60	0.32	0.23
M/P-XYLENE	ND (0.29)	ND (0.12)		ND (0.44)									ND (0.096)	ND (0.099)	ND (0.095)
O-XYLENE	ND (0.14)	ND (0.062)		ND (0.22)									ND (0.048)	ND (0.050)	ND (0.047)

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS														
	B-1 (15'-20')	B-3 (15'-20')	B-3 (15'-20') (25-28")	B-4 (15'-20')	B-4 (15'-20') (21-24")	B-5 (3-6')	B-5 (6-11')	B-7 (3-6')	B-7 (6-11')	B-8 (1-3')	B-8 (3-6')	B-8 (6-11')	BTM-GT-1	BTM-GT-2	ESW-GT-1
SW-846 6010C/D (mg/Kg dry) Metals Digestion													ND (2.9)	ND (2.7)	ND (2.8)
ANTIMONY													7.4	ND (2.7)	14
ARSENIC													34	27	43
BARIUM													ND (0.29)	ND (0.27)	ND (0.28)
BERYLLIUM													0.36	0.34	1.0
CADMIUM													11	10	14
CHROMIUM (as +3)													100	41	290
LEAD													11	8.9	23
NICKEL													ND (5.9)	ND (5.4)	ND (5.6)
SELENIUM													ND (0.59)	ND (0.54)	ND (0.56)
SILVER													ND (2.9)	ND (2.7)	ND (2.8)
THALLIUM															
VANADIUM						55	30	31	14		39	41	27	14	36
ZINC													37	43	210
SW-846 7471B (mg/Kg dry) Metals Digestion															
MERCURY													0.14	0.095	0.63
SW-846 8082A (mg/Kg dry)															
PCB 1016						ND (0.57)	ND (0.12)	ND (0.55)	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
PCB 1221						ND (0.57)	ND (0.12)	ND (0.55)	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
PCB 1232						ND (0.57)	ND (0.12)	ND (0.55)	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
PCB 1242						ND (0.57)	ND (0.12)	ND (0.55)	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
PCB 1248						ND (0.57)	ND (0.12)	ND (0.55)	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
PCB 1254						ND (0.57)	ND (0.12)	ND (0.55)	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
PCB 1260						3.8	0.29	2.2	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
PCB 1262						ND (0.57)	ND (0.12)	ND (0.55)	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
PCB 1268						ND (0.57)	ND (0.12)	ND (0.55)	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)
TOTAL PCBs						3.8	0.29	2.2	ND (0.11)	ND (0.10)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS														
	B-1 (15'-20')	B-3 (15'-20')	B-3 (15'-20') (25-28")	B-4 (15'-20')	B-4 (15'-20') (21-24")	B-5 (3-6')	B-5 (6-11')	B-7 (3-6')	B-7 (6-11')	B-8 (1-3')	B-8 (3-6')	B-8 (6-11')	BTM-GT-1	BTM-GT-2	ESW-GT-1
SW-846 8081B (mg/kg dry)													ND (0.0058)	ND (0.055)	ND (0.0056)
ALDRIN													ND (0.0058)	ND (0.055)	ND (0.0056)
ALPHA-BHC													ND (0.0058)	ND (0.055)	ND (0.0056)
BETA-BHC													ND (0.0058)	ND (0.055)	ND (0.0056)
DELTA-BHC													ND (0.0058)	ND (0.055)	ND (0.0056)
GAMMA-BHC (LINDANE)													ND (0.0023)	ND (0.022) *	ND (0.0022)
CHLORDANE													ND (0.023)	ND (0.22)	ND (0.022)
4,4'-DDD													ND (0.0046)	ND (0.044)	ND (0.0045)
4,4'-DDE													ND (0.0046)	ND (0.044)	ND (0.0045)
4,4'-DDT													ND (0.0046)	ND (0.044)	ND (0.0045)
DIELDRIN													ND (0.0046)	ND (0.044)	ND (0.0045)
ENDOSULFAN I													ND (0.0058)	ND (0.055)	ND (0.0056)
ENDOSULFAN II													ND (0.0092)	ND (0.088)	ND (0.0089)
ENDOSULFAN SULFATE													ND (0.0092)	ND (0.088)	ND (0.0089)
ENDRIN													ND (0.0092)	ND (0.088)	ND (0.0089)
ENDRIN KETONE													ND (0.0092)	ND (0.088)	ND (0.0089)
HEPTACHLOR													ND (0.0058)	ND (0.055)	ND (0.0056)
HEPTACHLOR EPOXIDE													ND (0.0058)	ND (0.055)	ND (0.0056)
HEXAChLOROBENZENE													ND (0.0069)	ND (0.066)	ND (0.0067)
METHOXYCHLOR													ND (0.058)	ND (0.55)	ND (0.056)
SW-846 8151A (mg/kg dry)															
2,4-D															
2,4-DB															
2,4,5-TP (SILVEX)															
2,4,5-T															
DALAPON															
DICAMBA															
DICHLOROPROP															
DINOSEB															
MCPA															
MCPP															
NOTES:															
1. An asterisk (*) following a detection limit indicates that the minimum laboratory reporting limit exceeds one or more of the regul. criteria.	9. SP-3 was analyzed for VPH via MADEP's Method and for VOCs via USEPA Method 8260C. No VPH or VOCs were detected. It was also analyzed for SVOCs via USEPA Method 8270. Only PAHs and dibenzofuran were detected and they are reported with the EPH data.														
2. ND = Not detected above the lab reporting limits shown in parenthesis.	10. B-7 (03') and B-10 (0-3') were analyzed for PAHs via both MassDEP's Method and USEPA Method 8270D. For each PAH, the highest detected value for both methods is provided in this table.														
3. NT = Not tested.															
4. ~ = No Method 1 Standard or UCL available	11. Soils were excavated and some were placed in the coal chute, which was modified to be a soil repository.														
5. Bolded values exceed the Method 1 Cleanup Standards (exclusive of S-x/GW-1).	SP-2 stockpile soils were placed in the coal chute first, then the remainder of the coal chute was backfilled with excavated soils from east section of courtyard. Soil soils were also placed in dry wells no. 2 to 4, located between B-11 and the utility void. The remaining soils from the east end excavation were stockpiled in the west end of the courtyard.														
6. Italic values exceed MassDEP published background conc. for soils assoc. with fill containing coal ash or wood ash.	Approximately 300 to 400 cubic yards of soils are located in the stockpile.														

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS													
	NSW-GT-1	NSW-GT-2	SSW-GT-1	SSW-GT-2	WSW-GT-2	FO-1	FO-1-BTM	B-14 (10-15)	B-14A (0-5)	B-14A (5-10)	B-14A (10-15)	B-14A (10-15)	B-14A (15-16.5)	B-15 (0-5)
Sampling Date	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/10/2016	3/10/2016	9/15/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/15/2016
Sample Depth During Investigative Event	3-4 Feet	5-6 Feet	3-4 Feet	5-6 Feet	5-6 Feet	7-8 feet (under vault, oily material)	Vault bottom (5.5 feet below grade)	10-15 Feet	0-5 Feet	5-10 Feet	10-15 Feet	10-15 Feet	15-16.5 Feet	0-5 Feet
Sample Depth Relative to October 1, 2016	0-1 Feet	2-3 Feet	0-1 Feet	2-3 Feet	2-3 Feet	4-5 feet (under vault, oil material)	2.5 Feet	10-15 Feet	0-5 Feet	5-10 Feet	10-15 Feet	10-15 Feet	15-16.5 Feet	0-5 Feet
NOTES:						8	8							
MADEP-EPH-04-1.1 (mg/Kg dry)						via 8270C								
C9-C18 ALIPHATICS	34	ND (22)	ND (11)	37	ND (11)				2400	1300	8300		220	
C19-C36 ALIPHATICS	140	77	17	200	ND (11)				3400	2100	11000		420	
C11-C22 AROMATICS	420	120	31	210	33				7200	2500	15000		1600	
ACENAPHTHENE	1.7	0.37	ND (0.11)	ND (0.43)	ND (0.11)	4.9			ND (2.9)	ND (0.56)	ND (2.4)		ND (1.3)	
ACENAPHTHYLENE	ND (0.23)	ND (0.22)	ND (0.11)	ND (0.43)	ND (0.11)	ND (3.8) *			ND (2.9) *	ND (0.56)	ND (2.4) *		ND (1.3) *	
ANTHRACENE	4.7	0.73	ND (0.11)	ND (0.43)	0.18	4.9			ND (2.9)	1.4	11		ND (1.3)	
BENZO(A)ANTHRACENE	10	1.7	ND (0.11)	0.78	0.5	4.8			ND (2.9)	ND (0.56)	ND (2.4)		ND (1.3)	
BENZO(A)PYRENE	9.3	0.69	0.24	0.94	0.52	ND (3.8) *			ND (2.9) *	ND (0.56)	ND (2.4) *		ND (1.3)	
BENZO(B)FLUORANTHENE	13	2	0.31	1.1	0.67	ND (3.8)			ND (2.9)	ND (0.56)	ND (2.4)		ND (1.3)	
BENZO(G,H,I)PERYLENE	4.9	0.96	0.33	0.77	0.41	ND (3.8)			ND (2.9)	ND (0.56)	ND (2.4)		ND (1.3)	
BENZO(K)FLUORANTHENE	4.8	0.73	ND (0.11)	0.44	0.26	ND (3.8)			ND (2.9)	ND (0.56)	ND (2.4)		ND (1.3)	
CHRYSENE	12	1.8	0.17	1.0	0.59	6.6			ND (2.9)	ND (0.56)	ND (2.4)		ND (1.3)	
DIBENZ(A,H)ANTHRACENE	1.5	ND (0.22)	ND (0.11)	ND (0.43)	ND (0.11)	ND (3.8) *			ND (2.9) *	ND (0.56)	ND (2.4) *		ND (1.3) *	
FLUORANTHENE	27	3.7	0.19	1.6	1.1	6.4			12	4.6	22		ND (1.3)	
FLUORENE	2.1	0.37	ND (0.11)	ND (0.43)	ND (0.11)	11			ND (2.9)	3.1	29		4.9	
INDENO(1,2,3-CD)PYRENE	5.2	0.93	0.25	0.56	0.36	ND (3.8)			ND (2.9)	ND (0.56)	ND (2.4)		ND (1.3)	
2-METHYLNAPHTHALENE	0.48	ND (0.22)	ND (0.11)	ND (0.43)	ND (0.11)	33			12	5.7	65		1.9	
NAPHTHALENE	0.70	ND (0.22)	ND (0.11)	ND (0.43)	ND (0.11)	8.3			ND (2.9)	3.1	27		ND (1.3)	
PHENANTHRENE	19	3	0.24	1.2	0.74	32			12	4.0	35		4.6	
PYRENE	25	3.4	0.19	1.6	1	33			7.1	1.7	12		ND (1.3)	
BIS(2-ETHYLHEXYL)PHTHALATE (see note 7)						ND (7.5)								
DIBENZOFURAN (see notes 7, 9)						ND (7.5)								
DI-N-BUTYLPHthalate (see note 7)						ND (7.5)								
MADEP-VPH-04-1.1 (mg/Kg dry)														
C5-C8 ALIPHATICS	ND (8.6)	ND (8.3)	ND (10)	ND (11)	ND (8.2)		ND (8.3)							
C9-C12 ALIPHATICS	ND (8.6)	ND (8.3)	ND (10)	ND (11)	ND (8.2)		ND (8.3)							
C9-C10 AROMATICS	ND (8.6)	ND (8.3)	ND (10)	ND (11)	ND (8.2)		ND (8.3)							
BENZENE	ND (0.043)	ND (0.042)	ND (0.052)	ND (0.053)	ND (0.041)		ND (0.042)							
ETHYLBENZENE	ND (0.043)	ND (0.042)	ND (0.052)	ND (0.053)	ND (0.041)		ND (0.042)							
METHYL TERT-BUTYL ETHER (MTBE)	ND (0.043)	ND (0.042)	ND (0.052)	ND (0.053)	ND (0.041)		ND (0.042)							
NAPHTHALENE	ND (0.22)	ND (0.21)	ND (0.26)	ND (0.26)	ND (0.20)		ND (0.21)							
TOLUENE	0.14	ND (0.042)	0.25	0.087	ND (0.041)		ND (0.042)							
M/P-XYLENE	ND (0.086)	ND (0.083)	ND (0.10)	ND (0.11)	ND (0.082)		ND (0.083)							
O-XYLENE	ND (0.043)	ND (0.042)	ND (0.052)	ND (0.053)	ND (0.041)		ND (0.042)							

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS													
	NSW-GT-1	NSW-GT-2	SSW-GT-1	SSW-GT-2	WSW-GT-2	FO-1	FO-1-BTM	B-14 (10-15)	B-14A (0-5)	B-14A (5-10)	B-14A (10-15)	B-14A (10-15)	B-14A (15-16.5)	B-15 (0-5)
SW-846 6010C/D (mg/Kg dry) Metals Digestion														
ANTIMONY	ND (2.6)	ND (2.8)	ND (2.8)	ND (2.8)	ND (2.7)	ND (3.4)	ND (2.5)							
ARSENIC	9.8	6.0	3.1	5.7	4.4	ND (3.4)	7.0							
BARIUM	72	42	27	31	28	36	30							
BERYLLIUM	ND (0.26)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.27)	0.58	ND (0.25)							
CADMIUM	0.81	0.61	ND (0.28)	0.60	0.33	ND (0.34)	0.26							
CHROMIUM (as +3)	26	19	12	18	11	3.1	20							
LEAD	230	64	58	59	40	8.5	6.3							
NICKEL	22	14	9.0	18	8.8	8.9	14							
SELENIUM	ND (5.3)	ND (5.6)	ND (5.6)	ND (5.5)	ND (5.5)	ND (6.8)	ND (5.0)							
SILVER	ND (0.53)	ND (0.56)	ND (0.56)	ND (0.55)	ND (0.55)	ND (0.68)	ND (0.50)							
THALLIUM	ND (2.6)	ND (2.8)	ND (2.8)	ND (2.8)	ND (2.7)	ND (3.4)	ND (2.5)							
VANADIUM	100	32	14	50	15	42	29							
ZINC	140	89	42	79	35	5.1	29							
SW-846 7471B (mg/Kg dry) Metals Digestion														
MERCURY	1.3	0.25	0.10	0.51	0.099	ND (0.035)	ND (0.026)							
SW-846 8082A (mg/Kg dry)														
PCB 1016	ND (1.1)*	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.14)	ND (0.11)		ND (0.15)	ND (0.11)	ND (0.12)		ND (0.13)	ND (2.2)*
PCB 1221	ND (1.1)*	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.14)	ND (0.11)		ND (0.15)	ND (0.11)	ND (0.12)		ND (0.13)	ND (2.2)*
PCB 1232	ND (1.1)*	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.14)	ND (0.11)		ND (0.15)	ND (0.11)	ND (0.12)		ND (0.13)	ND (2.2)*
PCB 1242	ND (1.1)*	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.14)	ND (0.11)		ND (0.15)	ND (0.11)	ND (0.12)		ND (0.13)	ND (2.2)*
PCB 1248	ND (1.1)*	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.14)	ND (0.11)		ND (0.15)	ND (0.11)	ND (0.12)		ND (0.13)	ND (2.2)*
PCB 1254	6.3	1.2	ND (0.11)	0.35	0.16	0.45	ND (0.11)		ND (0.15)	0.14	0.14		ND (0.13)	12
PCB 1260	ND (1.1)*	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.14)	ND (0.11)		ND (0.15)	ND (0.11)	ND (0.12)		ND (0.13)	ND (2.2)*
PCB 1262	ND (1.1)*	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.14)	ND (0.11)		ND (0.15)	ND (0.11)	ND (0.12)		ND (0.13)	ND (2.2)*
PCB 1268	ND (1.1)*	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.14)	ND (0.11)		ND (0.15)	ND (0.11)	ND (0.12)		ND (0.13)	ND (2.2)*
TOTAL PCBs	6.3	1.2	ND (0.11)	0.35	0.16	0.45	ND (0.11)		ND (0.15)	0.14	0.14		ND (0.13)	12

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS													
	NSW-GT-1	NSW-GT-2	SSW-GT-1	SSW-GT-2	WSW-GT-2	FO-1	FO-1-BTM	B-14 (10-15)	B-14A (0-5)	B-14A (5-10)	B-14A (10-15)	B-14A (10-15)	B-14A (15-16.5)	B-15 (0-5)
SW-846 8081B (mg/Kg dry)														
ALDRIN	ND (0.11) *	ND (0.11) *	ND (0.0056)	ND (0.11) *	ND (0.0055)	ND (0.69) *	ND (0.0054)							
ALPHA-BHC	ND (0.11)	ND (0.11)	ND (0.0056)	ND (0.11)	ND (0.0055)	ND (0.69)	ND (0.0054)							
BETA-BHC	ND (0.11)	ND (0.11)	ND (0.0056)	ND (0.11)	ND (0.0055)	ND (0.69)	ND (0.0054)							
DELTA-BHC	ND (0.11)	ND (0.11)	ND (0.0056)	ND (0.11)	ND (0.0055)	ND (0.69)	ND (0.0054)							
GAMMA-BHC (LINDANE)	ND (0.045) *	ND (0.044) *	ND (0.0022)	ND (0.043) *	ND (0.0022)	ND (0.28) *	ND (0.0022)							
CHLORDANE	ND (0.45)	ND (0.44)	ND (0.022)	ND (0.43)	0.045	ND (2.8)	ND (0.022)							
4,4'-DDD	ND (0.090)	ND (0.088)	ND (0.0045)	ND (0.087)	ND (0.0044)	ND (0.56)	ND (0.0043)							
4,4'-DDE	ND (0.090)	ND (0.088)	ND (0.0045)	ND (0.087)	ND (0.0044)	ND (0.56)	ND (0.0043)							
4,4'-DDT	ND (0.090)	ND (0.088)	ND (0.0045)	ND (0.087)	ND (0.0044)	ND (0.56)	ND (0.0043)							
DIFLDRIN	0.11	ND (0.088) *	ND (0.0045)	ND (0.087) *	ND (0.0044)	ND (0.56) *	ND (0.0043)							
ENDOSULFAN I	ND (0.11)	ND (0.11)	ND (0.0056)	ND (0.11)	ND (0.0055)	ND (0.69) *	ND (0.0054)							
ENDOSULFAN II	ND (0.18)	ND (0.18)	ND (0.0089)	ND (0.17)	ND (0.0088)	ND (1.1) *	ND (0.0086)							
ENDOSULFAN SULFATE	ND (0.18)	ND (0.18)	ND (0.0089)	ND (0.17)	ND (0.0088)	ND (1.1)	ND (0.0086)							
ENDRIN	ND (0.18)	ND (0.18)	ND (0.0089)	ND (0.17)	ND (0.0088)	ND (1.1)	ND (0.0086)							
ENDRIN KETONE	ND (0.18)	ND (0.18)	ND (0.0089)	ND (0.17)	ND (0.0088)	ND (1.1)	ND (0.0086)							
HEPTACHLOR	ND (0.11)	ND (0.11)	ND (0.0056)	ND (0.11)	ND (0.0055)	ND (0.69) *	ND (0.0054)							
HEPTACHLOR EPOXIDE	ND (0.11) *	ND (0.11) *	ND (0.0056)	ND (0.11) *	ND (0.0055)	ND (0.69) *	ND (0.0054)							
HEXAChLOROBENZENE	ND (0.14)	ND (0.13)	ND (0.0067)	ND (0.13)	ND (0.0066)	ND (0.83) *	ND (0.0065)							
METHOXYCHLOR	ND (1.1)	ND (1.1)	ND (0.056)	ND (1.1)	ND (0.055)	ND (6.9)	ND (0.054)							
SW-846 8151A (mg/kg dry)														
2,4-D							ND (0.027)							
2,4-DB							ND (0.027)							
2,4,5-TP (SILVEX)							ND (0.0027)							
2,4,5-T							ND (0.0027)							
DALAPON							ND (0.068)							
DICAMBA							ND (0.0027)							
DICHLOROPROP							ND (0.027)							
DINOSEB							ND (0.014)							
MCPA							ND (2.7)							
MCPP							ND (2.7)							
NOTES:														
1. An asterisk (*) following a detection limit indicates that the minimum laboratory reporting limit exceeds one or more of the regul. criteria.	12. These soils contain >50 mg/kg PCBs and were excavated and transported off-site to a hazardous waste facility approved to accept >50 mg/kg PCBs.													
2. ND = Not detected above the lab reporting limits shown in parenthesis.	13. Sample hydrocarbon fingerprinted via USEPA Method 8015C. Hydrocarbon was identified as Fuel Oil No. 6.													
3. NT = Not tested.	14. EPH extraction for B-18(5-10), B-19 (5-10) and B-19 (10-15) was conducted on day 29 after sample collection, more than 2 times the extraction hold period of 14 days. This data is used only for qualitative purposes to evaluate distribution of petroleum contamination.													
4. ~ = No Method 1 Standard or UCL available	5. Bolded values exceed the Method 1 Cleanup Standards (exclusive of S-x/GW-1).													
6. Italic values exceed MassDEP published background conc. for soils assoc. with fill containing coal ash or wood ash.														

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS													
	B-15 (5-10)	B-16 (0-5)	B-16 (5-10)	B-16 (10-15)	B-17 (5-7.5)	B-18 (0-5)	B-18 (5-10)	B-18 (10-15)	B-19 (0-5)	B-19 (5-10)	B-19 (10-15)	B-19 (15-17)	B-20 (0-5)	B-20 (5-8)
Sampling Date	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/16/2016	9/16/2016
Sample Depth During Investigative Event	5-10 Feet	0-5 Feet	5-10 Feet	10-15 Feet	5-7.5 Feet	0-5 Feet	5-10 Feet	10-15 Feet	0-5 Feet	5-10 Feet	10-15 Feet	15-17 Feet	0-5 Feet	5-8 Feet
Sample Depth Relative to October 1, 2016	5-10 Feet	0-5 Feet	5-10 Feet	10-15 Feet	5-7.5 Feet	0-5 Feet	5-10 Feet	10-15 Feet	0-5 Feet	5-10 Feet	10-15 Feet	15-17 Feet	0-5 Feet	5-8 Feet
NOTES:						14				14	14			
MADEP-EPH-04-1.1 (mg/kg dry)														
C9-C18 ALIPHATICS	140			150	85		28	59		20	110	200		ND (11)
C19-C36 ALIPHATICS	4700			380	670		33	310		70	370	730		32
C11-C22 AROMATICS	3700			850	650		90	530		220	570	1600		67
ACENAPHTHENE	ND (1.1)			ND (0.20)	ND (0.21)		ND (0.12)	ND (0.52)		1.3	ND (0.53)	ND (0.53)		ND (0.11)
ACENAPHTHYLENE	ND (1.1) *			ND (0.20)	ND (0.21)		ND (0.12)	ND (0.52)		ND (0.11)	ND (0.53)	ND (0.53)		ND (0.11)
ANTHRACENE	ND (1.1)			ND (0.20)	ND (0.21)		ND (0.12)	ND (0.52)		2.5	ND (0.53)	ND (0.53)		ND (0.11)
BENZO(A)ANTHRACENE	ND (1.1)			ND (0.20)	ND (0.21)		ND (0.12)	ND (0.52)		6	ND (0.53)	ND (0.53)		0.14
BENZO(A)PYRENE	ND (1.1)			ND (0.20)	ND (0.21)		ND (0.12)	ND (0.52)		5.1	ND (0.53)	ND (0.53)		0.12
BENZO(B)FLUORANTHENE	ND (1.1)			ND (0.20)	ND (0.21)		0.15	ND (0.52)		7	ND (0.53)	ND (0.53)		0.23
BENZO(G,H,I)PERYLENE	ND (1.1)			ND (0.20)	ND (0.21)		ND (0.12)	ND (0.52)		2.7	ND (0.53)	ND (0.53)		0.13
BENZO(K)FLUORANTHENE	ND (1.1)			ND (0.20)	ND (0.21)		ND (0.12)	ND (0.52)		2.6	ND (0.53)	ND (0.53)		ND (0.11)
CHRYSENE	ND (1.1)			ND (0.20)	ND (0.21)		0.25	ND (0.52)		6.7	ND (0.53)	ND (0.53)		0.28
DIBENZI(A,H)ANTHRACENE	ND (1.1) *			ND (0.20)	ND (0.21)		ND (0.12)	ND (0.52)		0.9	ND (0.53)	ND (0.53)		ND (0.11)
FLUORANTHENE	ND (1.1)			ND (0.20)	ND (0.21)		0.15	ND (0.52)		14	ND (0.53)	ND (0.53)		0.3
FLUORENE	ND (1.1)			ND (0.20)	ND (0.21)		0.13	ND (0.52)		1.3	ND (0.53)	ND (0.53)		ND (0.11)
INDENO(1,2,3-CD)PYRENE	ND (1.1)			ND (0.20)	ND (0.21)		ND (0.12)	ND (0.52)		3.3	ND (0.53)	ND (0.53)		ND (0.11)
2-METHYLNAPHTHALENE	ND (1.1) *			ND (0.20)	ND (0.21)		0.16	ND (0.52)		0.99	ND (0.53)	ND (0.53)		ND (0.11)
NAPHTHALENE	ND (1.1)			ND (0.20)	ND (0.21)		0.31	ND (0.52)		0.44	ND (0.53)	ND (0.53)		ND (0.11)
PHENANTHRENE	ND (1.1)			ND (0.20)	0.63		0.49	ND (0.52)		11	ND (0.53)	ND (0.53)		0.37
PYRENE	ND (1.1)			ND (0.20)	ND (0.21)		0.18	ND (0.52)		13	ND (0.53)	ND (0.53)		0.37
BIS(2-ETHYLHEXYL)PHTHALATE (see note 7)														
DIBENZOFURAN (see notes 7, 9)														
DI-N-BUTYLPHthalate (see note 7)														
MADEP-VPH-04-1.1 (mg/kg dry)														
C5-C8 ALIPHATICS														
C9-C12 ALIPHATICS														
C9-C10 AROMATICS														
BENZENE														
ETHYLBENZENE														
METHYL TERT-BUTYL ETHER (MTBE)														
NAPHTHALENE														
TOLUENE														
M/P-XYLENE														
O-XYLENE														

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS													
	B-15 (5-10)	B-16 (0-5)	B-16 (5-10)	B-16 (10-15)	B-17 (5-7.5)	B-18 (0-5)	B-18 (5-10)	B-18 (10-15)	B-19 (0-5)	B-19 (5-10)	B-19 (10-15)	B-19 (15-17)	B-20 (0-5)	B-20 (5-8)
SW-846 6010C/D (mg/Kg dry) Metals Digestion														
ANTIMONY														
ARSENIC														
BARIUM														
BERYLLIUM														
CADMIUM														
CHROMIUM (as +3)														
LEAD														
NICKEL														
SELENIUM														
SILVER														
THALLIUM														
VANADIUM														
ZINC														
SW-846 7471B (mg/Kg dry) Metals Digestion														
MERCURY														
SW-846 8082A (mg/Kg dry)														
PCB 1016	ND (0.11)	ND (0.11)				ND (5.5) *	ND (0.12)	ND (0.10)	ND (1.1) *	ND (0.42)	ND (0.11)		ND (0.11)	
PCB 1221	ND (0.11)	ND (0.11)				ND (5.5) *	ND (0.12)	ND (0.10)	ND (1.1) *	ND (0.42)	ND (0.11)		ND (0.11)	
PCB 1232	ND (0.11)	ND (0.11)				ND (5.5) *	ND (0.12)	ND (0.10)	ND (1.1) *	ND (0.42)	ND (0.11)		ND (0.11)	
PCB 1242	ND (0.11)	ND (0.11)				ND (5.5) *	ND (0.12)	ND (0.10)	ND (1.1) *	ND (0.42)	ND (0.11)		ND (0.11)	
PCB 1248	ND (0.11)	ND (0.11)				ND (5.5) *	ND (0.12)	ND (0.10)	ND (1.1) *	ND (0.42)	ND (0.11)		ND (0.11)	
PCB 1254	0.30	0.90				29	ND (0.12)	ND (0.10)	6.7	2.1	ND (0.11)		ND (0.11)	
PCB 1260	ND (0.11)	ND (0.11)				ND (5.5) *	ND (0.12)	ND (0.10)	ND (1.1) *	ND (0.42)	ND (0.11)		ND (0.11)	
PCB 1262	ND (0.11)	ND (0.11)				ND (5.5) *	ND (0.12)	ND (0.10)	ND (1.1) *	ND (0.42)	ND (0.11)		ND (0.11)	
PCB 1268	ND (0.11)	ND (0.11)				ND (5.5) *	ND (0.12)	ND (0.10)	ND (1.1) *	ND (0.42)	ND (0.11)		ND (0.11)	
TOTAL PCBs	0.30	0.90				29	ND (0.12)	ND (0.10)	6.7	2.1	ND (0.11)		ND (0.11)	

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS													
	B-15 (5-10)	B-16 (0-5)	B-16 (5-10)	B-16 (10-15)	B-17 (5-7.5)	B-18 (0-5)	B-18 (5-10)	B-18 (10-15)	B-19 (0-5)	B-19 (5-10)	B-19 (10-15)	B-19 (15-17)	B-20 (0-5)	B-20 (5-8)
SW-846 8081B (mg/kg dry)														
ALDRIN														
ALPHA-BHC														
BETA-BHC														
DELTA-BHC														
GAMMA-BHC (LINDANE)														
CHLORDANE														
4,4'-DDD														
4,4'-DDE														
4,4'-DDT														
DIELDRIN														
ENDOSULFAN I														
ENDOSULFAN II														
ENDOSULFAN SULFATE														
ENDRIN														
ENDRIN KETONE														
HEPTACHLOR														
HEPTACHLOR EPOXIDE														
HEXACHLOROBENZENE														
METHOXYCHLOR														
SW-846 8151A (mg/kg dry)														
2,4-D														
2,4-DB														
2,4,5-TP (SILVEX)														
2,4,5-T														
DALAPON														
DICAMBA														
DICHLOROPROP														
DINOSEB														
MCPA														
MCPP														
NOTES:														
1. An asterisk (*) following a detection limit indicates that the minimum laboratory reporting limit exceeds one or more of the regul. criteria.														
2. ND = Not detected above the lab reporting limits shown in parenthesis.														
3. NT = Not tested.														
4. ~ = No Method 1 Standard or UCL available														
5. Bolded values exceed the Method 1 Cleanup Standards (exclusive of S-x/GW-1).														
6. Italic values exceed MassDEP published background conc. for soils assoc. with fill containing coal ash or wood ash.														

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS									SUMMARY STATISTICS			EVALUATION	
	B-21 (0-5)	B-21 (5-10)	B-21 (10-13.5)	B-22 (10-15)	B-22 (15-20)	B-23 (5-9)	B-26 (10-13)	B-27 (5-10)	B-28 (10-15)	Number	Number	Maximum Concentration	Does Maximum	Soil
Sampling Date	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	Analyzed	Detected	Detected	Concentration	Contaminant of Concern
Sample Depth During Investigative Event	0-5 Feet	5-10 Feet	10-13.5 Feet	10-15 Feet	15-20 Feet	5-9 Feet	10-13 Feet	5-10 Feet	10-15 Feet				Exceed Background Concentration for Fill?	
Sample Depth Relative to October 1, 2016	0-5 Feet	5-10 Feet	10-13.5 Feet	10-15 Feet	15-20 Feet	5-9 Feet	10-13 Feet	5-10 Feet	10-15 Feet					
NOTES:														
MADEP-EPH-04-1.1 (mg/Kg dry)														
C9-C18 ALIPHATICS	28	860	110	63	ND (11)	ND (11)				34	24	8300	Not applicable	Yes
C19-C36 ALIPHATICS	180	1200	500	330	ND (11)	18				34	31	11000	Not applicable	Yes
C11-C22 AROMATICS	390	2400	1000	560	ND (11)	48				34	33	15000	Not applicable	Yes
ACENAPHTHENE	1.6	ND (0.52)	ND (0.55)	ND (0.24)	ND (0.11)	0.32				35	9	4.9	Yes	Yes
ACENAPHTHYLENE	ND (0.22)	ND (0.52)	ND (0.55)	ND (0.24)	ND (0.11)	ND (0.11)				35	1	0.11	No	Yes - a
ANTHRACENE	3	ND (0.52)	ND (0.55)	0.28	ND (0.11)	0.32				35	16	11	Yes	Yes
BENZO(A)ANTHRACENE	6.7	ND (0.52)	ND (0.55)	0.53	ND (0.11)	1.2				35	16	10	Yes	Yes
BENZO(A)PYRENE	6.3	ND (0.52)	ND (0.55)	0.64	ND (0.11)	1.3				35	17	9.3	Yes	Yes
BENZO(B)FLUORANTHENE	8.3	ND (0.52)	ND (0.55)	0.85	ND (0.11)	1.6				35	18	13	Yes	Yes
BENZO(G,H,I)PERYLENE	3.2	ND (0.52)	ND (0.55)	ND (0.24)	ND (0.11)	0.82				35	15	4.9	Yes	Yes
BENZO(K)FLUORANTHENE	3.2	ND (0.52)	ND (0.55)	ND (0.24)	ND (0.11)	0.57				35	12	4.8	Yes	Yes
CHRYSENE	7.9	ND (0.52)	ND (0.55)	0.74	ND (0.11)	1.3				35	20	12	Yes	Yes
DIBENZ(A,H)ANTHRACENE	1.2	ND (0.52)	ND (0.55)	ND (0.24)	ND (0.11)	0.19				35	6	1.5	Yes	Yes
FLUORANTHENE	18	1.8	ND (0.55)	1.8	ND (0.11)	2.8				35	26	27	Yes	Yes
FLUORENE	1.7	1.5	ND (0.55)	ND (0.24)	ND (0.11)	0.15				35	15	29	Yes	Yes
INDENO(1,2,3-CD)PYRENE	3.9	ND (0.52)	ND (0.55)	ND (0.24)	ND (0.11)	0.79				35	14	5.2	Yes	Yes
2-METHYLNAPHTHALENE	0.39	ND (0.52)	ND (0.55)	ND (0.24)	ND (0.11)	ND (0.11)				35	13	65	No	Yes
NAPHTHALENE	0.41	ND (0.52)	ND (0.55)	ND (0.24)	ND (0.11)	0.18				35	14	27	Yes	Yes
PHENANTHRENE	14	3.3	ND (0.55)	0.41	ND (0.11)	1.9				35	26	35	Yes	Yes
PYRENE	17	ND (0.52)	ND (0.55)	1.7	ND (0.11)	2.7				35	23	33	Yes	Yes
BIS(2-ETHYLHEXYL)PHTHALATE (see note 7)										1	0		Not applicable	No
DIBENZOFURAN (see notes 7, 9)										1	0		Not applicable	No
DI-N-BUTYLPHthalate (see note 7)										1	0		Not applicable	No
MADEP-VPH-04-1.1 (mg/Kg dry)														
C5-C8 ALIPHATICS										12	0			No
C9-C12 ALIPHATICS										12	0			No
C9-C10 AROMATICS										12	3	100	Not applicable	Yes
BENZENE										12	5	0.52	Not applicable	Yes
ETHYLBENZENE										12	0			No
METHYL TERT-BUTYL ETHER (MTBE)										12	0			No
NAPHTHALENE										12	0			No
TOLUENE										12	7	0.6	Not applicable	Yes
M/P-XYLENE										12	0			No
O-XYLENE										12	0			No

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS									SUMMARY STATISTICS			EVALUATION	
	B-21 (0-5)	B-21 (5-10)	B-21 (10-13.5)	B-22 (10-15)	B-22 (15-20)	B-23 (5-9)	B-26 (10-13)	B-27 (5-10)	B-28 (10-15)	Number	Number	Maximum Concentration	Does Maximum	Soil
SW-846 6010C/D (mg/Kg dry) Metals Digestion										10	0			
ANTIMONY										10	8	14	No	No
ARSENIC										10	9	72	Yes	Yes
BARIUM										10	0		No	No
BERYLLIUM										10	8	1	No	No
CADMIUM										10	9	26	No	No
CHROMIUM (as +3)										10	9	290	No	No
LEAD										10	9	23	No	No
NICKEL										10	0		No	No
SELENIUM										10	0		No	No
SILVER										10	0		No	No
THALLIUM										10	0		No	No
VANADIUM										16	15	100	Yes	Yes
ZINC										10	9	210	No	No
SW-846 7471B (mg/Kg dry) Metals Digestion										10	8	1.3	Yes	Yes
MERCURY														
SW-846 8082A (mg/Kg dry)														
PCB 1016	ND (2.2) *	ND (0.11)	ND (0.11)											
PCB 1221	ND (2.2) *	ND (0.11)	ND (0.11)											
PCB 1232	ND (2.2) *	ND (0.11)	ND (0.11)											
PCB 1242	ND (2.2) *	ND (0.11)	ND (0.11)											
PCB 1248	ND (2.2) *	ND (0.11)	ND (0.11)											
PCB 1254	11	0.63	ND (0.11)											
PCB 1260	ND (2.2) *	0.12	ND (0.11)											
PCB 1262	ND (2.2) *	ND (0.11)	ND (0.11)											
PCB 1268	ND (2.2) *	ND (0.11)	ND (0.11)											
TOTAL PCBs	11	0.75	ND (0.11)							34	18	29	Not applicable	Yes

Table D-1
Comparison of Soil Analytical Data to Background Concentrations and Identification of Soil Contaminants of Concern

Parameter	SAMPLING LOCATIONS									SUMMARY STATISTICS			EVALUATION	
	B-21 (0-5)	B-21 (5-10)	B-21 (10-13.5)	B-22 (10-15)	B-22 (15-20)	B-23 (5-9)	B-26 (10-13)	B-27 (5-10)	B-28 (10-15)	Number	Number	Maximum Concentration	Does Maximum	Soil
SW-846 8081B (mg/Kg dry)														
ALDRIN										10	0			No
ALPHA-BHC										10	0			No
BETA-BHC										10	0			No
DELTA-BHC										10	0			No
GAMMA-BHC (LINDANE)										10	0			No
CHLORDANE										10	1	0.045	Not applicable	Yes
4,4'-DDD										10	0			No
4,4'-DDE										10	0			No
4,4'-DDT										10	0			No
DIELDRIN										10	1	0.11	Not applicable	Yes
ENDOSULFAN I										10	0			No
ENDOSULFAN II										10	0			No
ENDOSULFAN SULFATE										10	0			No
ENDRIN										10	0			No
ENDRIN KETONE										10	0			No
HEPTACHLOR										10	0			No
HEPTACHLOR EPOXIDE										10	0			No
HEXACHLOROBENZENE										10	0			No
METHOXYCHLOR										10	0			No
SW-846 8151A (mg/kg dry)														
2,4-D										1	0			No
2,4-DB										1	0			No
2,4,5-TP (SILVEX)										1	0			No
2,4,5-T										1	0			No
DALAPON										1	0			No
DICAMBA										1	0			No
DICHLOROPROP										1	0			No
DINOSEB										1	0			No
MCPA										1	0			No
MCPP										1	0			No
NOTES:														
1. An asterisk (*) following a detection limit indicates that the minimum laboratory reporting limit exceeds one or more of the regul. criteria.														
2. ND = Not detected above the lab reporting limits shown in parenthesis.														
3. NT = Not tested.														
4. ~ = No Method 1 Standard or UCL available														
5. Bolded values exceed the Method 1 Cleanup Standards (exclusive of S-x/GW-1).														
6. Italic values exceed MassDEP published background conc. for soils assoc. with fill containing coal ash or wood ash.														

Table D-2
Evaluation of 0-3 Foot Interval Data to Determine Method to Derive Exposure Point Concentrations

Parameter	MCP - Method 2 Direct Contact Standards			Upper Concentration Limit	SAMPLING LOCATIONS											
	S-1	S-2	S-3		UCL	B-5 (3-6')	B-7 (3-6')	B-8 (1-3')	BTM-GT-1	ESW-GT-1	NSW-GT-1	NSW-GT-2	SSW-GT-1	SSW-GT-2	WSW-GT-2	FO-1-BTM
Sampling Date					3/14/2016	3/14/2016	3/14/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/10/2016
Sample Depth Relative to October 1, 2016					0-3 Feet	0-3 Feet	0-2 Feet	3 Feet	0-1 Feet	0-1 Feet	2-3 Feet	0-1 Feet	2-3 Feet	2-3 Feet	2-3 Feet	2.5 Feet
MADEP-EPH-04-1.1 (mg/kg dry)																
C9-C18 ALIPHATICS	1000	3000	5000	20000	26	ND (11)			ND (12)	13	34	ND (22)	ND (11)	37	ND (11)	
C19-C36 ALIPHATICS	3000	5000	5000	20000	64	28			ND (12)	29	140	77	17	200	ND (11)	
C11-C22 AROMATICS	1000	3000	5000	10000	220	83			25	41	420	120	31	210	33	
ACENAPHTHENE	1000	3000	5000	10000	0.76	0.54			ND (0.12)	ND (0.11)	1.7	0.37	ND (0.11)	ND (0.43)	ND (0.11)	
ACENAPHTHYLENE	600	600	600	10000	0.11	ND (0.11)			ND (0.12)	ND (0.11)	ND (0.23)	ND (0.22)	ND (0.11)	ND (0.43)	ND (0.11)	
ANTHRACENE	1000	3000	5000	10000	1.8	1.4			ND (0.12)	ND (0.11)	4.7	0.73	ND (0.11)	ND (0.43)	0.18	
BENZO(A)ANTHRACENE	7	40	300	3000	4.1	2.9			ND (0.12)	ND (0.11)	10	1.7	ND (0.11)	0.78	0.5	
BENZO(A)PYRENE	2	7	30	300	3.7	2.4			0.27	ND (0.11)	9.3	0.69	0.24	0.94	0.52	
BENZO(B)FLUORANTHENE	7	40	300	3000	5.3	3.3			0.32	ND (0.11)	13	2	0.31	1.1	0.67	
BENZO(G,H,I)PERYLENE	1000	3000	5000	10000	1.7	1.2			0.38	ND (0.11)	4.9	0.96	0.33	0.77	0.41	
BENZO(K)FLUORANTHENE	70	400	3000	10000	2.0	1.2			ND (0.12)	ND (0.11)	4.8	0.73	ND (0.11)	0.44	0.26	
CHRYSENE	70	400	3000	10000	5.0	3.2			0.15	ND (0.11)	12	1.8	0.17	1.0	0.59	
DIBENZ(A,H)ANTHRACENE	0.7	4	30	300	0.65	0.41			ND (0.12)	ND (0.11)	1.5	ND (0.22)	ND (0.11)	ND (0.43)	ND (0.11)	
FLUORANTHENE	1000	3000	5000	10000	9.5	6.6			0.15	0.14	27	3.7	0.19	1.6	1.1	
FLUORENE	1000	3000	5000	10000	0.90	0.78			ND (0.12)	ND (0.11)	2.1	0.37	ND (0.11)	ND (0.43)	ND (0.11)	
INDENO(1,2,3-CD)PYRENE	7	40	300	3000	2.1	1.3			0.36	ND (0.11)	5.2	0.93	0.25	0.56	0.36	
2-METHYLNAPHTHALENE	300	500	500	5000	0.29	0.22			ND (0.12)	ND (0.11)	0.48	ND (0.22)	ND (0.11)	ND (0.43)	ND (0.11)	
NAPHTHALENE	500	1000	3000	10000	0.44	0.32			ND (0.12)	ND (0.11)	0.70	ND (0.22)	ND (0.11)	ND (0.43)	ND (0.11)	
PHENANTHRENE	500	1000	3000	10000	7.4	6.1			0.34	0.4	19	3	0.24	1.2	0.74	
PYRENE	1000	3000	5000	10000	8.8	5.9			ND (0.12)	0.13	25	3.4	0.19	1.6	1	
MADEP-VPH-04-1.1 (mg/Kg dry)																
C9-C10 AROMATICS	100	500	500	5000					ND (9.6)	ND (9.5)	ND (8.6)	ND (8.3)	ND (10)	ND (11)	ND (8.2)	ND (8.3)
BENZENE	40	200	1000	10000					0.10	0.15	ND (0.043)	ND (0.042)	ND (0.052)	ND (0.053)	ND (0.041)	ND (0.042)
TOLUENE	500	1000	3000	10000					0.60	0.23	0.14	ND (0.042)	0.25	0.087	ND (0.041)	ND (0.042)
SW-846 6010C/D (mg/Kg dry) Metals Digestion																
BARIUM	1000	3000	5000	10000					34	43	72	42	27	31	28	30
VANADIUM	400	700	700	7000	55	31			27	36	100	32	14	50	15	29
SW-846 7471B (mg/Kg dry) Metals Digestion																
MERCURY	20	30	30	300					0.14	0.63	1.3	0.25	0.10	0.51	0.099	ND (0.026)
SW-846 8082A (mg/Kg dry)																
TOTAL PCBs	1	4	4	100	3.8	2.2	ND (0.10)	ND (0.11)	ND (0.11)	6.3	1.2	ND (0.11)	0.35	0.16	ND (0.11)	
SW-846 8081B (mg/Kg dry)																
CHLORDANE	5	30	60	600					ND (0.023)	ND (0.022)	ND (0.45)	ND (0.44)	ND (0.022)	ND (0.43)	0.045	ND (0.022)
DIELDRIN	0.08	0.5	3	30					ND (0.0046)	ND (0.0045)	0.11	ND (0.088)*	ND (0.0045)	ND (0.087)*	ND (0.004)	ND (0.0043)
NOTES:																

Table D-2
Evaluation of 0-3 Foot Interval Data to Determine Method to Derive Exposure Point Concentrations

Parameter	SAMPLING LOCATIONS							EVALUATION					
	B-14A (0-5)	B-15 (0-5)	B-16 (0-5)	B-18 (0-5)	B-19 (0-5)	B-20 (0-5)	B-21 (0-5)	Number	Maximum Concentration	More than 10X >S-2?	% >S-2	Method to Derive	
Sampling Date	9/16/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/16/2016	9/16/2016	Analyzed	Detected			Exposure Point Conc.	
Sample Depth Relative to October 1, 2016	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet						
MADEP-EPH-04-1.1 (mg/Kg dry)													
C9-C18 ALIPHATICS	2400							28	11	2400	No	0	Mean
C19-C36 ALIPHATICS	3400							180	11	3400	No	0	Mean
C11-C22 AROMATICS	7200							390	11	7200	No	9.1	Mean
ACENAPHTHENE	ND (2.9)							1.6	11	1.7	No	0	Mean
ACENAPHTHYLENE	ND (2.9) *							ND (0.22)	11	0.11	No	0	Mean
ANTHRACENE	ND (2.9)							3	11	4.7	No	0	Mean
BENZO(A)ANTHRACENE	ND (2.9)							6.7	11	10	No	0	Mean
BENZO(A)PYRENE	ND (2.9) *							6.3	11	9.3	No	9.1	Mean
BENZO(B)FLUORANTHENE	ND (2.9)							8.3	11	13	No	0	Mean
BENZO(G,H,I)PERYLENE	ND (2.9)							3.2	11	4.9	No	0	Mean
BENZO(K)FLUORANTHENE	ND (2.9)							3.2	11	4.8	No	0	Mean
CHRYSENE	ND (2.9)							7.9	11	12	No	0	Mean
DIBENZ(A,H)ANTHRACENE	ND (2.9) *							1.2	11	1.5	No	0	Mean
FLUORANTHENE	12							18	11	27	No	0	Mean
FLUORENE	ND (2.9)							1.7	11	2.1	No	0	Mean
INDENO(1,2,3-CD)PYRENE	ND (2.9)							3.9	11	5.2	No	0	Mean
2-METHYLNAPHTHALENE	12							0.39	11	12	No	0	Mean
NAPHTHALENE	ND (2.9)							0.41	11	0.7	No	0	Mean
PHENANTHRENE	12							14	11	19	No	0	Mean
PYRENE	7.1							17	11	25	No	0	Mean
MADEP-VPH-04-1.1 (mg/Kg dry)													
C9-C10 AROMATICS								8	0	No	0	0	Mean
BENZENE								8	0.15	No	0	0	Mean
TOLUENE								8	0.6	No	0	0	Mean
SW-846 6010C/D (mg/Kg dry) Metals Digestion													
BARIUM								8	72	No	0	0	Mean
VANADIUM								10	100	No	0	0	Mean
SW-846 7471B (mg/Kg dry) Metals Digestion													
MERCURY								8	1.3	No	0	0	Mean
SW-846 8082A (mg/Kg dry)													
TOTAL PCBs	ND (0.15)	12	0.90	29	6.7	ND (0.11)	11	18	29	No	28	95th % UCL on mean	
SW-846 8081B (mg/Kg dry)													
CHLORDANE								8	0.045	No	0	0	Mean
DIELDRIN								8	0.11	No	0	0	Mean
NOTES:													
												95th % UCL on mean = 95th % upper confidence limit on the mean	

Table D-3
Evaluation of 3-6 Foot Interval Data to Determine Method to Derive Exposure Point Concentrations

Parameter	MCP - Method 2 Direct Contact Standards			Upper Concentration Limit	SAMPLING LOCATIONS											
	S-1	S-2	S-3		B-14A (0-5)	B-15 (0-5)	B-16 (0-5)	B-18 (0-5)	B-19 (0-5)	B-20 (0-5)	B-21 (0-5)	BTM-GT-2	FO-1	B-5 (6-11')		
Sampling Date					9/16/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/16/2016	9/16/2016	3/8/2016	3/10/2016	3/14/2016		
Sample Depth Relative to October 1, 2016					0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	5 Feet	4-5 feet (under vault, oil material)	3-8 Feet		
MADEP-EPH-04-1.1 (mg/Kg dry)														via 8270C		
C9-C18 ALIPHATICS	1000	3000	5000	20000	2400								28	ND (11)	300	
C19-C36 ALIPHATICS	3000	5000	5000	20000	3400								180	31	750	
C11-C22 AROMATICS	1000	3000	5000	10000	7200								390	45	1400	
ACENAPHTHENE	1000	3000	5000	10000	ND (2.9)								1.6	ND (0.11)	4.9	ND (0.49)
ACENAPHTHYLENE	600	600	600	10000	ND (2.9) *								ND (0.22)	ND (0.11)	ND (3.8) *	ND (0.49)
ANTHRACENE	1000	3000	5000	10000	ND (2.9)								3	ND (0.11)	4.9	ND (0.49)
BENZO(A)ANTHRACENE	7	40	300	3000	ND (2.9)								6.7	ND (0.11)	4.8	ND (0.49)
BENZO(A)PYRENE	2	7	30	300	ND (2.9) *								6.3	0.11	ND (3.8) *	ND (0.49)
BENZO(B)FLUORANTHENE	7	40	300	3000	ND (2.9)								8.3	0.15	ND (3.8)	ND (0.49)
BENZO(G,H,I)PERYLENE	1000	3000	5000	10000	ND (2.9)								3.2	ND (0.11)	ND (3.8)	ND (0.49)
BENZO(K)FLUORANTHENE	70	400	3000	10000	ND (2.9)								3.2	ND (0.11)	ND (3.8)	ND (0.49)
CHRYSENE	70	400	3000	10000	ND (2.9)								7.9	0.11	6.6	ND (0.49)
DIBENZ(A,H)ANTHRACENE	0.7	4	30	300	ND (2.9) *								1.2	ND (0.11)	ND (3.8) *	ND (0.49)
FLUORANTHENE	1000	3000	5000	10000	12								18	0.17	6.4	1.2
FLUORENE	1000	3000	5000	10000	ND (2.9)								1.7	ND (0.11)	11	ND (0.49)
INDENO(1,2,3-CD)PYRENE	7	40	300	3000	ND (2.9)								3.9	ND (0.11)	ND (3.8)	ND (0.49)
2-METHYLNAPHTHALENE	300	500	500	5000	12								0.39	ND (0.11)	33	0.70
NAPHTHALENE	500	1000	3000	10000	ND (2.9)								0.41	ND (0.11)	8.3	0.79
PHENANTHRENE	500	1000	3000	10000	12								14	ND (0.11)	32	1.6
PYRENE	1000	3000	5000	10000	7.1								17	0.18	33	ND (0.49)
MADEP-VPH-04-1.1 (mg/Kg dry)																
C9-C10 AROMATICS	100	500	500	5000										ND (9.9)		
BENZENE	40	200	1000	10000										0.058		
TOLUENE	500	1000	3000	10000										0.32		
SW-846 6010C/D (mg/Kg dry) Metals Digestion																
BARIUM	1000	3000	5000	10000									27	36		
VANADIUM	400	700	700	7000									14	42	30	
SW-846 7471B (mg/Kg dry) Metals Digestion																
MERCURY	20	30	30	300										0.095	ND (0.035)	
SW-846 8082A (mg/Kg dry)																
TOTAL PCBs	1	4	4	100	ND (0.15)	12	0.90	29	6.7	ND (0.11)	11	ND (0.11)	0.45	0.29		
SW-846 8081B (mg/Kg dry)																
CHLORDANE	5	30	60	600									ND (0.22)	ND (2.8)		
DIELDRIN	0.08	0.5	3	30									ND (0.044)	ND (0.56) *		
NOTES:																

Table D-3
Evaluation of 3-6 Foot Interval Data to Determine Method to Derive Exposure Point Concentrations

Parameter	SAMPLING LOCATIONS		
	B-7 (6-11')	B-8 (3-6')	B-17 (5-7.5)
Sampling Date	3/14/2016	3/14/2016	9/15/2016
Sample Depth Relative to October 1, 2016	3-8 Feet	2-5 Feet	5-7.5 Feet
<i>MADEP-EPH-04-1.1 (mg/Kg dry)</i>			
C9-C18 ALIPHATICS	ND (22)		85
C19-C36 ALIPHATICS	48		670
C11-C22 AROMATICS	83		650
ACENAPHTHENE	ND (0.22)		ND (0.21)
ACENAPHTHYLENE	ND (0.22)		ND (0.21)
ANTHRACENE	0.29		ND (0.21)
BENZO(A)ANTHRACENE	1.2		ND (0.21)
BENZO(A)PYRENE	1.1		ND (0.21)
BENZO(B)FLUORANTHENE	1.3		ND (0.21)
BENZO(G,H,I)PERYLENE	0.66		ND (0.21)
BENZO(K)FLUORANTHENE	0.52		ND (0.21)
CHRYSENE	1.3		ND (0.21)
DIBENZ(A,H)ANTHRACENE	ND (0.22)		ND (0.21)
FLUORANTHENE	2.3		ND (0.21)
FLUORENE	ND (0.22)		ND (0.21)
INDENO(1,2,3-CD)PYRENE	0.56		ND (0.21)
2-METHYLNAPHTHALENE	ND (0.22)		ND (0.21)
NAPHTHALENE	ND (0.22)		ND (0.21)
PHENANTHRENE	1.2		0.63
PYRENE	2.4		ND (0.21)
<i>MADEP-VPH-04-1.1 (mg/Kg dry)</i>			
C9-C10 AROMATICS			
BENZENE			
TOLUENE			
<i>SW-846 6010C/D (mg/Kg dry) Metals Digestion</i>			
BARIUM			
VANADIUM	14	39	
<i>SW-846 7471B (mg/Kg dry) Metals Digestion</i>			
MERCURY			
<i>SW-846 8082A (mg/Kg dry)</i>			
TOTAL PCBs	ND (0.11)	ND (0.11)	
<i>SW-846 8081B (mg/Kg dry)</i>			
CHLORDANE			
DIELDRIN			
NOTES:			

Table D-3
Evaluation of 3-6 Foot Interval Data to Determine Method to Derive Exposure Point Concentrations

Parameter	EVALUATION				
	Number	Maximum Concentration	More than 10X >S-2?	% >S-2	Method to Derive
Sampling Date	Analyzed	Detected			Exposure Point Conc.
Sample Depth Relative to October 1, 2016					
MADEP-EPH-04-1.1 (mg/Kg dry)					
C9-C18 ALIPHATICS	6	2400	No	0	Mean
C19-C36 ALIPHATICS	6	3400	No	0	Mean
C11-C22 AROMATICS	6	7200	No	16.7	Mean
ACENAPHTHENE	7	4.9	No	0	Mean
ACENAPHTHYLENE	7	0	No	0	Mean
ANTHRACENE	7	4.9	No	0	Mean
BENZO(A)ANTHRACENE	7	6.7	No	0	Mean
BENZO(A)PYRENE	7	6.3	No	14.3	Mean
BENZO(B)FLUORANTHENE	7	8.3	No	0	Mean
BENZO(G,H,I)PERYLENE	7	3.2	No	0	Mean
BENZO(K)FLUORANTHENE	7	3.2	No	0	Mean
CHRYSENE	7	7.9	No	0	Mean
DIBENZ(A,H)ANTHRACENE	7	1.2	No	0	Mean
FLUORANTHENE	7	18	No	0	Mean
FLUORENE	7	11	No	0	Mean
INDENO(1,2,3-CD)PYRENE	7	3.9	No	0	Mean
2-METHYLNAPHTHALENE	7	33	No	0	Mean
NAPHTHALENE	7	8.3	No	0	Mean
PHENANTHRENE	7	32	No	0	Mean
PYRENE	7	33	No	0	Mean
MADEP-VPH-04-1.1 (mg/Kg dry)					
C9-C10 AROMATICS	1	0	No	0	Mean
BENZENE	1	0.058	No	0	Mean
TOLUENE	1	0.32	No	0	Mean
SW-846 6010C/D (mg/kg dry) Metals Digestion					
BARIUM	2	27	No	0	Mean
VANADIUM	5	39	No	0	Mean
SW-846 7471B (mg/Kg dry) Metals Digestion					
MERCURY	2	0.095	No	0	Mean
SW-846 8082A (mg/Kg dry)					
TOTAL PCBs	12	29	No	33	95th % UCL on mean
SW-846 8081B (mg/Kg dry)					
CHLORDANE	2	0	No	0	Mean
DIELDRIN	2	0	No	0	Mean
NOTES:					
			95th % UCL on mean = 95th % upper confidence limit on the mean		

Table D-4
Evaluation of 6-20 Foot Interval Data to Determine Method to Derive Exposure Point Concentrations

Parameter	MCP - Method 2 Direct Contact Standards			Upper Concentration Limit	SAMPLING LOCATIONS										
	S-1	S-2	S-3		UCL	B-5 (6'-11')	B-7 (6'-11')	B-17 (5'-7.5)	B-1 (15'-20')	B-3 (15'-20') (25'-28")	B-4 (15'-20') (21'-24")	B-4 (15'-20') (21'-24")	B-8 (6'-11')	B-14 (10'-15')	
Sampling Date						3/14/2016	3/14/2016	9/15/2016	8/14/2015	8/14/2015	8/14/2015	8/14/2015	8/14/2015	9/15/2016	
Sample Depth Relative to October 1, 2016						3-8 Feet	3-8 Feet	5-7.5 Feet	12-17 Feet	14-19 Feet	14-19 Feet	12-17 Feet	12-17 Feet	5-10 Feet	10-15 Feet
MADEP-EPH-04-1.1 (mg/Kg dry)															
C9-C18 ALIPHATICS	1000	3000	5000	20000	300	ND (22)	85	810	48			570			
C19-C36 ALIPHATICS	3000	5000	5000	20000	750	48	670	1700	77			1200			
C11-C22 AROMATICS	1000	3000	5000	10000	1400	83	650	3400	200			3600			
ACENAPHTHENE	1000	3000	5000	10000	ND (0.49)	ND (0.22)	ND (0.21)	ND (0.22)	0.22			ND (0.22)			
ACENAPHTHYLENE	600	600	600	10000	ND (0.49)	ND (0.22)	ND (0.21)	ND (0.22)	ND (0.11)			ND (0.22)			
ANTHRACENE	1000	3000	5000	10000	ND (0.49)	0.29	ND (0.21)	1.9	0.65			5.4			
BENZO(A)ANTHRACENE	7	40	300	3000	ND (0.49)	1.2	ND (0.21)	3.0	1.1			7.4			
BENZO(A)PYRENE	2	7	30	300	ND (0.49)	1.1	ND (0.21)	ND (0.22)	0.88			5.5			
BENZO(B)FLUORANTHENE	7	40	300	3000	ND (0.49)	1.3	ND (0.21)	ND (0.22)	1.2			7.1			
BENZO(G,H,I)PERYLENE	1000	3000	5000	10000	ND (0.49)	0.66	ND (0.21)	ND (0.22)	0.58			1.5			
BENZO(K)FLUORANTHENE	70	400	3000	10000	ND (0.49)	0.52	ND (0.21)	ND (0.22)	0.43			2.5			
CHRYSENE	70	400	3000	10000	ND (0.49)	1.3	ND (0.21)	3.8	1.2			7.8			
DIBENZ(A,H)ANTHRACENE	0.7	4	30	300	ND (0.49)	ND (0.22)	ND (0.21)	ND (0.22)	ND (0.11)			ND (0.22)			
FLUORANTHENE	1000	3000	5000	10000	1.2	2.3	ND (0.21)	3.5	2.3			15			
FLUORENE	1000	3000	5000	10000	ND (0.49)	ND (0.22)	ND (0.21)	3.5	0.44			6.9			
INDENO(1,2,3-CD)PYRENE	7	40	300	3000	ND (0.49)	0.56	ND (0.21)	ND (0.22)	0.51			2.6			
2-METHYLNAPHTHALENE	300	500	500	5000	0.70	ND (0.22)	ND (0.21)	0.49	ND (0.11)			3.1			
NAPHTHALENE	500	1000	3000	10000	0.79	ND (0.22)	ND (0.21)	1.3	0.12			2.1			
PHENANTHRENE	500	1000	3000	10000	1.6	1.2	0.63	5.3	1.9			21			
PYRENE	1000	3000	5000	10000	ND (0.49)	2.4	ND (0.21)	2.6	2.3			13			
MADEP-VPH-04-1.1 (mg/Kg dry)															
C9-C10 AROMATICS	100	500	500	5000					84	51		100			
BENZENE	40	200	1000	10000					0.26	ND (0.062)		0.52			
TOLUENE	500	1000	3000	10000					ND (0.14)	ND (0.062)		0.32			
SW-846 6010C/D (mg/Kg dry) Metals Digestion															
BARIUM	1000	3000	5000	10000											
VANADIUM	400	700	700	7000	30	14							41		
SW-846 7471B (mg/Kg dry) Metals Digestion															
MERCURY	20	30	30	300											
SW-846 8082A (mg/Kg dry)															
TOTAL PCBs	1	4	4	100	0.29	ND (0.11)						ND (0.11)			
SW-846 8081B (mg/Kg dry)															
CHLORDANE	5	30	60	600											
DIELDRIN	0.08	0.5	3	30											
NOTES:															

Table D-4
Evaluation of 6-20 Foot Interval Data to Determine Method to Derive Exposure Point Concentrations

Parameter	SAMPLING LOCATIONS														
	B-14A (5-10)	B-14A (10-15)	B-14A (10-15)	B-14A (15-16.5)	B-15 (5-10)	B-16 (5-10)	B-16 (10-15)	B-18 (5-10)	B-18 (10-15)	B-19 (5-10)	B-19 (10-15)	B-19 (15-17)	B-20 (5-8)	B-21 (5-10)	
Sampling Date	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/16/2016	9/16/2016	
Sample Depth Relative to October 1, 2016	5-10 Feet	10-15 Feet	10-15 Feet	15-16.5 Feet	5-10 Feet	5-10 Feet	10-15 Feet	5-10 Feet	10-15 Feet	5-10 Feet	10-15 Feet	15-17 Feet	5-8 Feet	5-10 Feet	
MADEP-EPH-04-1.1 (mg/Kg dry)															
C9-C18 ALIPHATICS	1300	8300			220	140		150	28	59	20	110	200	ND (11)	860
C19-C36 ALIPHATICS	2100	11000			420	4700		380	33	310	70	370	730	32	1200
C11-C22 AROMATICS	2500	15000			1600	3700		850	90	530	220	570	1600	67	2400
ACENAPHTHENE	ND (0.56)	ND (2.4)			ND (1.3)	ND (1.1)		ND (0.20)	ND (0.12)	ND (0.52)	1.3	ND (0.53)	ND (0.53)	ND (0.11)	ND (0.52)
ACENAPHTHYLENE	ND (0.56)	ND (2.4) *			ND (1.3) *	ND (1.1) *		ND (0.20)	ND (0.12)	ND (0.52)	ND (0.11)	ND (0.53)	ND (0.53)	ND (0.11)	ND (0.52)
ANTHRACENE	1.4	11			ND (1.3)	ND (1.1)		ND (0.20)	ND (0.12)	ND (0.52)	2.5	ND (0.53)	ND (0.53)	ND (0.11)	ND (0.52)
BENZO(A)ANTHRACENE	ND (0.56)	ND (2.4)			ND (1.3)	ND (1.1)		ND (0.20)	ND (0.12)	ND (0.52)	6	ND (0.53)	ND (0.53)	0.14	ND (0.52)
BENZO(A)PYRENE	ND (0.56)	ND (2.4) *			ND (1.3)	ND (1.1)		ND (0.20)	ND (0.12)	ND (0.52)	5.1	ND (0.53)	ND (0.53)	0.12	ND (0.52)
BENZO(B)FLUORANTHENE	ND (0.56)	ND (2.4)			ND (1.3)	ND (1.1)		ND (0.20)	0.15	ND (0.52)	7	ND (0.53)	ND (0.53)	0.23	ND (0.52)
BENZO(G,H,I)PERYLENE	ND (0.56)	ND (2.4)			ND (1.3)	ND (1.1)		ND (0.20)	ND (0.12)	ND (0.52)	2.7	ND (0.53)	ND (0.53)	0.13	ND (0.52)
BENZO(K)FLUORANTHENE	ND (0.56)	ND (2.4)			ND (1.3)	ND (1.1)		ND (0.20)	ND (0.12)	ND (0.52)	2.6	ND (0.53)	ND (0.53)	ND (0.11)	ND (0.52)
CHRYSENE	ND (0.56)	ND (2.4)			ND (1.3)	ND (1.1)		ND (0.20)	0.25	ND (0.52)	6.7	ND (0.53)	ND (0.53)	0.28	ND (0.52)
DIBENZ(A,H)ANTHRACENE	ND (0.56)	ND (2.4) *			ND (1.3) *	ND (1.1) *		ND (0.20)	ND (0.12)	ND (0.52)	0.9	ND (0.53)	ND (0.53)	ND (0.11)	ND (0.52)
FLUORANTHENE	4.6	22			ND (1.3)	ND (1.1)		ND (0.20)	0.15	ND (0.52)	14	ND (0.53)	ND (0.53)	0.3	1.8
FLUORENE	3.1	29			4.9	ND (1.1)		ND (0.20)	0.13	ND (0.52)	1.3	ND (0.53)	ND (0.53)	ND (0.11)	1.5
INDENO(1,2,3-CD)PYRENE	ND (0.56)	ND (2.4)			ND (1.3)	ND (1.1)		ND (0.20)	ND (0.12)	ND (0.52)	3.3	ND (0.53)	ND (0.53)	ND (0.11)	ND (0.52)
2-METHYLNAPHTHALENE	5.7	65			1.9	ND (1.1) *		ND (0.20)	0.16	ND (0.52)	0.99	ND (0.53)	ND (0.53)	ND (0.11)	ND (0.52)
NAPHTHALENE	3.1	27			ND (1.3)	ND (1.1)		ND (0.20)	0.31	ND (0.52)	0.44	ND (0.53)	ND (0.53)	ND (0.11)	ND (0.52)
PHENANTHRENE	4.0	35			4.6	ND (1.1)		ND (0.20)	0.49	ND (0.52)	11	ND (0.53)	ND (0.53)	0.37	3.3
PYRENE	1.7	12			ND (1.3)	ND (1.1)		ND (0.20)	0.18	ND (0.52)	13	ND (0.53)	ND (0.53)	0.37	ND (0.52)
MADEP-VPH-04-1.1 (mg/Kg dry)															
C9-C10 AROMATICS															
BENZENE															
TOLUENE															
SW-846 6010C/D (mg/Kg dry) Metals Digestion															
BARIUM															
VANADIUM															
SW-846 7471B (mg/Kg dry) Metals Digestion															
MERCURY															
SW-846 8082A (mg/Kg dry)															
TOTAL PCBs	0.14	0.14			ND (0.13)	0.30			ND (0.12)	ND (0.10)	2.1	ND (0.11)			0.75
SW-846 8081B (mg/Kg dry)															
CHLORDANE															
DIELDRIN															
NOTES:															

Table D-4
Evaluation of 6-20 Foot Interval Data to Determine Method to Derive Exposure Point Concentrations

Parameter	SAMPLING LOCATIONS							EVALUATION				
	B-21 (10-13.5)	B-22 (10-15)	B-22 (15-20)	B-23 (5-9)	B-26 (10-13)	B-27 (5-10)	B-28 (10-15)	Number	Maximum Concentration	More than 10X >S-2?	% >S-2	Method to Derive
Sampling Date	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	Analyzed	Detected			Exposure Point Conc.
Sample Depth Relative to October 1, 2016	10-13.5 Feet	10-15 Feet	15-20 Feet	5-9 Feet	10-13 Feet	5-10 Feet	10-15 Feet					
MADEP-EPH-04-1.1 (mg/Kg dry)												
C9-C18 ALIPHATICS	110	63	ND (11)	ND (11)				22	8300	No	4.5	Mean
C19-C36 ALIPHATICS	500	330	ND (11)	18				22	11000	No	4.5	Mean
C11-C22 AROMATICS	1000	560	ND (11)	48				22	15000	No	18	Mean
ACENAPHTHENE	ND (0.55)	ND (0.24)	ND (0.11)	0.32				22	1.3	No	0	Mean
ACENAPHTHYLENE	ND (0.55)	ND (0.24)	ND (0.11)	ND (0.11)				22	0	No	0	Mean
ANTHRACENE	ND (0.55)	0.28	ND (0.11)	0.32				22	11	No	0	Mean
BENZO(A)ANTHRACENE	ND (0.55)	0.53	ND (0.11)	1.2				22	7.4	No	0	Mean
BENZO(A)PYRENE	ND (0.55)	0.64	ND (0.11)	1.3				22	5.5	No	4.5	Mean
BENZO(B)FLUORANTHENE	ND (0.55)	0.85	ND (0.11)	1.6				22	7.1	No	0	Mean
BENZO(G,H,I)PERYLENE	ND (0.55)	ND (0.24)	ND (0.11)	0.82				22	2.7	No	0	Mean
BENZO(K)FLUORANTHENE	ND (0.55)	ND (0.24)	ND (0.11)	0.57				22	2.6	No	0	Mean
CHRYSENE	ND (0.55)	0.74	ND (0.11)	1.3				22	7.8	No	0	Mean
DIBENZ(A,H)ANTHRACENE	ND (0.55)	ND (0.24)	ND (0.11)	0.19				22	0.9	No	0	Mean
FLUORANTHENE	ND (0.55)	1.8	ND (0.11)	2.8				22	22	No	0	Mean
FLUORENE	ND (0.55)	ND (0.24)	ND (0.11)	0.15				22	29	No	0	Mean
INDENO(1,2,3-CD)PYRENE	ND (0.55)	ND (0.24)	ND (0.11)	0.79				22	3.3	No	0	Mean
2-METHYLNAPHTHALENE	ND (0.55)	ND (0.24)	ND (0.11)	ND (0.11)				22	65	No	0	Mean
NAPHTHALENE	ND (0.55)	ND (0.24)	ND (0.11)	0.18				22	27	No	0	Mean
PHENANTHRENE	ND (0.55)	0.41	ND (0.11)	1.9				22	35	No	0	Mean
PYRENE	ND (0.55)	1.7	ND (0.11)	2.7				22	13	No	0	Mean
MADEP-VPH-04-1.1 (mg/Kg dry)												
C9-C10 AROMATICS								3	100	No	0	Mean
BENZENE								3	0.52	No	0	Mean
TOLUENE								3	0.32	No	0	Mean
SW-846 6010C/D (mg/Kg dry) Metals Digestion												
BARIUM								no data				
VANADIUM								3	41	No	0	Mean
SW-846 7471B (mg/Kg dry) Metals Digestion												
MERCURY								no data				
SW-846 8082A (mg/Kg dry)												
TOTAL PCBs	ND (0.11)							13	2.1	No	0	95th % UCL on mean
SW-846 8081B (mg/Kg dry)												
CHLORDANE								no data				
DIELDRIN								no data				
NOTES:								95th % UCL on mean = 95th % upper confidence limit on the mean				

Table D-5
Derivation of Exposure Point Concentrations for Soils: 0-3 Foot Interval

Parameter	MCP - Method 2 Direct Contact Standards			Upper Concentration Limit	SAMPLING LOCATIONS												
	S-1	S-2	S-3		UCL	B-5 (3-6')	B-7 (3-6')	B-8 (1-3')	BTM-GT-1	ESW-GT-1	NSW-GT-1	NSW-GT-2	SSW-GT-1	SSW-GT-2	WSW-GT-2	FO-1-BTM	
Sampling Date					3/14/2016	3/14/2016	3/14/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/8/2016	3/10/2016	
Sample Depth Relative to October 1, 2016					0-3 Feet	0-3 Feet	0-2 Feet	3 Feet	0-1 Feet	0-1 Feet	2-3 Feet	0-1 Feet	2-3 Feet	2-3 Feet	2-3 Feet	2.5 Feet	
MADEP-EPH-04-1.1 (mg/kg dry)																	
C9-C18 ALIPHATICS	1000	3000	5000	20000	26	5.5		6	13	34	11	5.5	37	5.5			
C19-C36 ALIPHATICS	3000	5000	5000	20000	64	28		6	29	140	77	17	200	5.5			
C11-C22 AROMATICS	1000	3000	5000	10000	220	83		25	41	420	120	31	210	33			
ACENAPHTHENE	1000	3000	5000	10000	0.76	0.54		0.06	0.055	1.7	0.37	0.055	0.215	0.055			
ACENAPHTHYLENE	600	600	600	10000	0.11	0.055		0.06	0.055	0.115	0.11	0.055	0.215	0.055			
ANTHRACENE	1000	3000	5000	10000	1.8	1.4		0.06	0.055	4.7	0.73	0.055	0.215	0.18			
BENZO(A)ANTHRACENE	7	40	300	3000	4.1	2.9		0.06	0.055	10	1.7	0.055	0.78	0.5			
BENZO(A)PYRENE	2	7	30	300	3.7	2.4		0.27	0.055	9.3	0.69	0.24	0.94	0.52			
BENZO(B)FLUORANTHENE	7	40	300	3000	5.3	3.3		0.32	0.055	13	2	0.31	1.1	0.67			
BENZO(G,H,I)PERYLENE	1000	3000	5000	10000	1.7	1.2		0.38	0.055	4.9	0.96	0.33	0.77	0.41			
BENZO(K)FLUORANTHENE	70	400	3000	10000	2.0	1.2		0.06	0.055	4.8	0.73	0.055	0.44	0.26			
CHRYSENE	70	400	3000	10000	5.0	3.2		0.15	0.055	12	1.8	0.17	1.0	0.59			
DIBENZ(A,H)ANTHRACENE	0.7	4	30	300	0.65	0.41		0.06	0.055	1.5	0.11	0.055	0.215	0.055			
FLUORANTHENE	1000	3000	5000	10000	9.5	6.6		0.15	0.14	27	3.7	0.19	1.6	1.1			
FLUORENE	1000	3000	5000	10000	0.90	0.78		0.06	0.055	2.1	0.37	0.055	0.215	0.055			
INDENO(1,2,3-CD)PYRENE	7	40	300	3000	2.1	1.3		0.36	0.055	5.2	0.93	0.25	0.56	0.36			
2-METHYLNAPHTHALENE	300	500	500	5000	0.29	0.22		0.06	0.055	0.48	0.11	0.055	0.215	0.055			
NAPHTHALENE	500	1000	3000	10000	0.44	0.32		0.06	0.055	0.70	0.11	0.055	0.215	0.055			
PHENANTHRENE	500	1000	3000	10000	7.4	6.1		0.34	0.4	19	3	0.24	1.2	0.74			
PYRENE	1000	3000	5000	10000	8.8	5.9		0.06	0.13	25	3.4	0.19	1.6	1			
MADEP-VPH-04-1.1 (mg/Kg dry)																	
C9-C10 AROMATICS	100	500	500	5000						4.8	4.75	4.3	4.15	5	5.5	4.1	4.15
BENZENE	40	200	1000	10000						0.10	0.15	0.0215	0.021	0.026	0.0265	0.0205	0.021
TOLUENE	500	1000	3000	10000						0.60	0.23	0.14	0.021	0.25	0.087	0.0205	0.021
SW-846 6010C/D (mg/Kg dry) Metals Digestion																	
BARIUM	1000	3000	5000	10000						34	43	72	42	27	31	28	30
VANADIUM	400	700	700	7000	55	31				27	36	100	32	14	50	15	29
SW-846 7471B (mg/Kg dry) Metals Digestion																	
MERCURY	20	30	30	300						0.14	0.63	1.3	0.25	0.10	0.51	0.099	0.013
SW-846 8082A (mg/Kg dry)																	
TOTAL PCBs	1	4	4	100	3.8	2.2	0.05	0.055	0.055	6.3	1.2	0.055	0.35	0.16	0.055		
SW-846 8081B (mg/Kg dry)																	
CHLORDANE	5	30	60	600						0.0115	0.011	0.225	0.22	0.011	0.215	0.045	0.011
DIELDRIN	0.08	0.5	3	30						0.0023	0.00225	0.11	0.044	0.00225	0.0435	0.0022	0.0215
NOTES:																	

Table D-5
Derivation of Exposure Point Concentrations for Soils: 0-3 Foot Interval

Parameter	SAMPLING LOCATIONS							EXPOSURE POINT CONCENTRATION				
	B-14A (0-5)	B-15 (0-5)	B-16 (0-5)	B-18 (0-5)	B-19 (0-5)	B-20 (0-5)	B-21 (0-5)	Number	Mean Concentration (Population)	Standard Deviation	95th % Confidence	95th % UCL on mean
Sampling Date	9/16/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/16/2016	9/16/2016	Analyzed				
Sample Depth Relative to October 1, 2016	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet					
MADEP-EPH-04-1.1 (mg/Kg dry)												
C9-C18 ALIPHATICS	2400							28	11	234		
C19-C36 ALIPHATICS	3400							180	11	377		
C11-C22 AROMATICS	7200							390	11	798		
ACENAPHTHENE	1.45							1.6	11	0.624		
ACENAPHTHYLENE	1.45							0.11	11	0.217		
ANTHRACENE	1.45							3	11	1.24		
BENZO(A)ANTHRACENE	1.45							6.7	11	2.57		
BENZO(A)PYRENE	1.45							6.3	11	2.35		
BENZO(B)FLUORANTHENE	1.45							8.3	11	3.26		
BENZO(G,H,I)PERYLENE	1.45							3.2	11	1.40		
BENZO(K)FLUORANTHENE	1.45							3.2	11	1.30		
CHRYSENE	1.45							7.9	11	3.03		
DIBENZ(A,H)ANTHRACENE	1.45							1.2	11	0.524		
FLUORANTHENE	12							18	11	7.27		
FLUORENE	1.45							1.7	11	0.704		
INDENO(1,2,3-CD)PYRENE	1.45							3.9	11	1.50		
2-METHYLNAPHTHALENE	12							0.39	11	1.27		
NAPHTHALENE	1.45							0.41	11	0.352		
PHENANTHRENE	12							14	11	5.86		
PYRENE	7.1							17	11	6.38		
MADEP-VPH-04-1.1 (mg/Kg dry)												
C9-C10 AROMATICS								8		4.59		
BENZENE								8		0.0483		
TOLUENE								8		0.171		
SW-846 6010C/D (mg/Kg dry) Metals Digestion												
BARIUM								8		38.4		
VANADIUM								10		38.9		
SW-846 7471B (mg/Kg dry) Metals Digestion												
MERCURY								8		0.380		
SW-846 8082A (mg/Kg dry)												
TOTAL PCBs	0.075	12	0.90	29	6.7	0.055	11	18	4.111666667	7.102334906	3.281051036	7.39
SW-846 8081B (mg/Kg dry)												
CHLORDANE								8		0.094		
DIELDRIN								8		0.029		
NOTES:												
												95th % UCL on mean = 95th % upper confidence limit on the mean
												When none detected, one-half reported detection limit used to derive exposure
												point concentration.

Table D-6
Derivation of Exposure Point Concentrations for Soils: 3-6 Foot

Parameter	MCP - Method 2 Direct Contact Standards			Upper Concentration Limit	SAMPLING LOCATIONS											
	S-1	S-2	S-3		B-14A (0-5)	B-15 (0-5)	B-16 (0-5)	B-18 (0-5)	B-19 (0-5)	B-20 (0-5)	B-21 (0-5)	BTM-GT-2	FO-1	B-5 (6-11')		
Sampling Date					9/16/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/16/2016	9/16/2016	3/8/2016	3/10/2016	3/14/2016		
Sample Depth Relative to October 1, 2016					0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	0-5 Feet	5 Feet	4-5 feet (under vault, oil material)	3-8 Feet		
MADEP-EPH-04-1.1 (mg/Kg dry)														via 8270C		
C9-C18 ALIPHATICS	1000	3000	5000	20000	2400								28	5.5	300	
C19-C36 ALIPHATICS	3000	5000	5000	20000	3400								180	31	750	
C11-C22 AROMATICS	1000	3000	5000	10000	7200								390	45	1400	
ACENAPHTHENE	1000	3000	5000	10000	1.45								1.6	0.055	4.9	0.245
ACENAPHTHYLENE	600	600	600	10000	1.45								0.11	0.055	1.9	0.245
ANTHRACENE	1000	3000	5000	10000	1.45								3	0.055	4.9	0.245
BENZO(A)ANTHRACENE	7	40	300	3000	1.45								6.7	0.055	4.8	0.245
BENZO(A)PYRENE	2	7	30	300	1.45								6.3	0.11	1.9	0.245
BENZO(B)FLUORANTHENE	7	40	300	3000	1.45								8.3	0.15	1.9	0.245
BENZO(G,H,I)PYRELYNE	1000	3000	5000	10000	1.45								3.2	0.055	1.9	0.245
BENZO(K)FLUORANTHENE	70	400	3000	10000	1.45								3.2	0.055	1.9	0.245
CHRYSENE	70	400	3000	10000	1.45								7.9	0.11	6.6	0.245
DIBENZ(A,H)ANTHRACENE	0.7	4	30	300	1.45								1.2	0.055	1.9	0.245
FLUORANTHENE	1000	3000	5000	10000	12								18	0.17	6.4	1.2
FLUORENE	1000	3000	5000	10000	1.45								1.7	0.055	11	0.245
INDENO(1,2,3-CD)PYRENE	7	40	300	3000	1.45								3.9	0.055	1.9	0.245
2-METHYLNAPHTHALENE	300	500	500	5000	12								0.39	0.055	33	0.70
NAPHTHALENE	500	1000	3000	10000	1.45								0.41	0.055	8.3	0.79
PHENANTHRENE	500	1000	3000	10000	12								14	0.055	32	1.6
PYRENE	1000	3000	5000	10000	7.1								17	0.18	33	0.245
MADEP-VPH-04-1.1 (mg/Kg dry)																
C9-C10 AROMATICS	100	500	500	5000										4.95		
BENZENE	40	200	1000	10000										0.058		
TOLUENE	500	1000	3000	10000										0.32		
SW-846 6010C/D (mg/Kg dry) Metals Digestion																
BARIUM	1000	3000	5000	10000									27	36		
VANADIUM	400	700	700	7000									14	42	30	
SW-846 7471B (mg/Kg dry) Metals Digestion																
MERCURY	20	30	30	300										0.095	0.0175	
SW-846 8082A (mg/Kg dry)																
TOTAL PCBs	1	4	4	100	0.075	12	0.90	29	6.7	0.055	11	0.055	0.45	0.29		
SW-846 8081B (mg/Kg dry)																
CHLORDANE	5	30	60	600									0.11	1.4		
DIELDRIN	0.08	0.5	3	30									0.022	0.28		
NOTES:																

Table D-6
Derivation of Exposure Point Concentrations for Soils: 3-6 Foot

Parameter	SAMPLING LOCATIONS			EXPOSURE POINT CONCENTRATION					
	B-7 (6-11')	B-8 (3-6')	B-17 (5-7.5)	Number	Mean Concentration	Standard Deviation (Population)	95th % Confidence Limit	95th % UCL on mean	
Sampling Date	3/14/2016	3/14/2016	9/15/2016	Analyzed					
Sample Depth Relative to October 1, 2016	3-8 Feet	2-5 Feet	5-7.5 Feet						
MADEP-EPH-04-1.1 (mg/Kg dry)									
C9-C18 ALIPHATICS	11		85	6	472				
C19-C36 ALIPHATICS	48		670	6	847				
C11-C22 AROMATICS	83		650	6	1628				
ACENAPHTHENE	0.11		0.105	7	1.21				
ACENAPHTHYLENE	0.11		0.105	7	0.568				
ANTHRACENE	0.29		0.105	7	1.44				
BENZO(A)ANTHRACENE	1.2		0.105	7	2.08				
BENZO(A)PYRENE	1.1		0.105	7	1.60				
BENZO(B)FLUORANTHENE	1.3		0.105	7	1.92				
BENZO(G,H,I)PERYLENE	0.66		0.105	7	1.09				
BENZO(K)FLUORANTHENE	0.52		0.105	7	1.07				
CHRYSENE	1.3		0.105	7	2.53				
DIBENZ(A,H)ANTHRACENE	0.11		0.105	7	0.724				
FLUORANTHENE	2.3		0.105	7	5.74				
FLUORENE	0.11		0.105	7	2.10				
INDENO(1,2,3-CD)PYRENE	0.56		0.105	7	1.17				
2-METHYLNAPHTHALENE	0.11		0.105	7	6.62				
NAPHTHALENE	0.11		0.105	7	1.60				
PHENANTHRENE	1.2		0.63	7	8.78				
PYRENE	2.4		0.105	7	8.58				
MADEP-VPH-04-1.1 (mg/Kg dry)									
C9-C10 AROMATICS				1	4.95				
BENZENE				1	0.0580				
TOLUENE				1	0.320				
SW-846 6010C/D (mg/Kg dry) Metals Digestion									
BARIUM				2	27.0				
VANADIUM	14	39		5	24.3				
SW-846 7471B (mg/Kg dry) Metals Digestion									
MERCURY				2	0.056				
SW-846 8082A (mg/Kg dry)									
TOTAL PCBs	0.055	0.055		12	5.052916667	8.394545466	4.749573947	9.80	
SW-846 8081B (mg/Kg dry)									
CHLORDANE				2	0.755				
DIELDRIN				2	0.151				
NOTES:									
					95th % UCL on mean = 95th % upper confidence limit on the mean				
					When none detected, one-half reported detection limit used to derive exposure point concentration.				

Table D-7
Derivation of Exposure Point Concentrations for Soils: 6-20 Foot Interval

Parameter	MCP - Method 2 Direct Contact Standards			Upper Concentration Limit	SAMPLING LOCATIONS										
	S-1	S-2	S-3		UCL	B-5 (6'-11')	B-7 (6'-11')	B-17 (5'-7.5)	B-1 (15'-20')	B-3 (15'-20')	B-3 (15'-20') (25'-28")	B-4 (15'-20')	B-4 (15'-20') (21'-24")	B-8 (6'-11')	B-14 (10'-15')
Sampling Date						3/14/2016	3/14/2016	9/15/2016	8/14/2015	8/14/2015	8/14/2015	8/14/2015	8/14/2015	3/14/2016	9/15/2016
Sample Depth Relative to October 1, 2016						3-8 Feet	3-8 Feet	5-7.5 Feet	12-17 Feet	14-19 Feet	14-19 Feet	12-17 Feet	12-17 Feet	5-10 Feet	10-15 Feet
MADEP-EPH-04-1.1 (mg/Kg dry)															
C9-C18 ALIPHATICS	1000	3000	5000	20000	300	11	85	810	48			570			
C19-C36 ALIPHATICS	3000	5000	5000	20000	750	48	670	1700	77			1200			
C11-C22 AROMATICS	1000	3000	5000	10000	1400	83	650	3400	200			3600			
ACENAPHTHENE	1000	3000	5000	10000	0.245	0.11	0.105	0.11	0.22			0.11			
ACENAPHTHYLENE	600	600	600	10000	0.245	0.11	0.105	0.11	0.055			0.11			
ANTHRACENE	1000	3000	5000	10000	0.245	0.29	0.105	1.9	0.65			5.4			
BENZO(A)ANTHRACENE	7	40	300	3000	0.245	1.2	0.105	3.0	1.1			7.4			
BENZO(A)PYRENE	2	7	30	300	0.245	1.1	0.105	0.11	0.88			5.5			
BENZO(B)FLUORANTHENE	7	40	300	3000	0.245	1.3	0.105	0.11	1.2			7.1			
BENZO(G,H,I)PERYLENE	1000	3000	5000	10000	0.245	0.66	0.105	0.11	0.58			1.5			
BENZO(K)FLUORANTHENE	70	400	3000	10000	0.245	0.52	0.105	0.11	0.43			2.5			
CHRYSENE	70	400	3000	10000	0.245	1.3	0.105	3.8	1.2			7.8			
DIBENZ(A,H)ANTHRACENE	0.7	4	30	300	0.245	0.11	0.105	0.11	0.055			0.11			
FLUORANTHENE	1000	3000	5000	10000	1.2	2.3	0.105	3.5	2.3			15			
FLUORENE	1000	3000	5000	10000	0.245	0.11	0.105	3.5	0.44			6.9			
INDENO(1,2,3-CD)PYRENE	7	40	300	3000	0.245	0.56	0.105	0.11	0.51			2.6			
2-METHYLNAPHTHALENE	300	500	500	5000	0.70	0.11	0.105	0.49	0.055			3.1			
NAPHTHALENE	500	1000	3000	10000	0.79	0.11	0.105	1.3	0.12			2.1			
PHENANTHRENE	500	1000	3000	10000	1.6	1.2	0.63	5.3	1.9			21			
PYRENE	1000	3000	5000	10000	0.245	2.4	0.105	2.6	2.3			13			
MADEP-VPH-04-1.1 (mg/Kg dry)															
C9-C10 AROMATICS	100	500	500	5000					84	51		100			
BENZENE	40	200	1000	10000					0.26	0.031		0.52			
TOLUENE	500	1000	3000	10000					0.07	0.031		0.32			
SW-846 6010C/D (mg/Kg dry) Metals Digestion															
BARIUM	1000	3000	5000	10000											
VANADIUM	400	700	700	7000	30	14							41		
SW-846 7471B (mg/Kg dry) Metals Digestion															
MERCURY	20	30	30	300											
SW-846 8082A (mg/Kg dry)															
TOTAL PCBs	1	4	4	100	0.29	ND (0.11)						ND (0.11)			
SW-846 8081B (mg/Kg dry)															
CHLORDANE	5	30	60	600											
DIELDRIN	0.08	0.5	3	30											
NOTES:															

Table D-7
Derivation of Exposure Point Concentrations for Soils: 6-20 Foot Interval

Parameter	SAMPLING LOCATIONS														
	B-14A (5-10)	B-14A (10-15)	B-14A (10-15)	B-14A (15-16.5)	B-15 (5-10)	B-16 (5-10)	B-16 (10-15)	B-18 (5-10)	B-18 (10-15)	B-19 (5-10)	B-19 (10-15)	B-19 (15-17)	B-20 (5-8)	B-21 (5-10)	
Sampling Date	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/15/2016	9/16/2016	9/16/2016	
Sample Depth Relative to October 1, 2016	5-10 Feet	10-15 Feet	10-15 Feet	15-16.5 Feet	5-10 Feet	5-10 Feet	10-15 Feet	5-10 Feet	10-15 Feet	5-10 Feet	10-15 Feet	15-17 Feet	5-8 Feet	5-10 Feet	
MADEP-EPH-04-1.1 (mg/Kg dry)															
C9-C18 ALIPHATICS	1300	8300			220	140		150	28	59	20	110	200	ND (11)	860
C19-C36 ALIPHATICS	2100	11000			420	4700		380	33	310	70	370	730	32	1200
C11-C22 AROMATICS	2500	15000			1600	3700		850	90	530	220	570	1600	67	2400
ACENAPHTHENE	0.28	1.2			0.65	0.55		0.1	0.06	0.26	1.3	0.265	0.265	0.055	0.26
ACENAPHTHYLENE	0.28	1.2			0.65	0.55		0.1	0.06	0.26	0.055	0.265	0.265	0.055	0.26
ANTHRACENE	1.4	11			0.65	0.55		0.1	0.06	0.26	2.5	0.265	0.265	0.055	0.26
BENZO(A)ANTHRACENE	0.28	1.2			0.65	0.55		0.1	0.06	0.26	6	0.265	0.265	0.14	0.26
BENZO(A)PYRENE	0.28	1.2			0.65	0.55		0.1	0.06	0.26	5.1	0.265	0.265	0.12	0.26
BENZO(B)FLUORANTHENE	0.28	1.2			0.65	0.55		0.1	0.15	0.26	7	0.265	0.265	0.23	0.26
BENZO(G,H,I)PERYLENE	0.28	1.2			0.65	0.55		0.1	0.06	0.26	2.7	0.265	0.265	0.13	0.26
BENZO(K)FLUORANTHENE	0.28	1.2			0.65	0.55		0.1	0.06	0.26	2.6	0.265	0.265	0.055	0.26
CHRYSENE	0.28	1.2			0.65	0.55		0.1	0.25	0.26	6.7	0.265	0.265	0.28	0.26
DIBENZ(A,H)ANTHRACENE	0.28	1.2			0.65	0.55		0.1	0.06	0.26	0.9	0.265	0.265	0.055	0.26
FLUORANTHENE	4.6	22			0.65	0.55		0.1	0.15	0.26	14	0.265	0.265	0.3	1.8
FLUORENE	3.1	29			4.9	0.55		0.1	0.13	0.26	1.3	0.265	0.265	0.055	1.5
INDENO(1,2,3-CD)PYRENE	0.28	1.2			0.65	0.55		0.1	0.06	0.26	3.3	0.265	0.265	0.055	0.26
2-METHYLNAPHTHALENE	5.7	65			1.9	0.55		0.1	0.16	0.26	0.99	0.265	0.265	0.055	0.26
NAPHTHALENE	3.1	27			0.65	0.55		0.1	0.31	0.26	0.44	0.265	0.265	0.055	0.26
PHENANTHRENE	4.0	35			4.6	0.55		0.1	0.49	0.26	11	0.265	0.265	0.37	3.3
PYRENE	1.7	12			0.65	0.55		0.1	0.18	0.26	13	0.265	0.265	0.37	0.26
MADEP-VPH-04-1.1 (mg/Kg dry)															
C9-C10 AROMATICS															
BENZENE															
TOLUENE															
SW-846 6010C/D (mg/Kg dry) Metals Digestion															
BARIUM															
VANADIUM															
SW-846 7471B (mg/Kg dry) Metals Digestion															
MERCURY															
SW-846 8082A (mg/Kg dry)															
TOTAL PCBs	0.14	0.14			ND (0.13)	0.30			ND (0.12)	ND (0.10)	2.1	ND (0.11)			0.75
SW-846 8081B (mg/Kg dry)															
CHLORDANE															
DIELDRIN															
NOTES:															

Table D-7
Derivation of Exposure Point Concentrations for Soils: 6-20 Foot Interval

Parameter	SAMPLING LOCATIONS							EXPOSURE POINT CONCENTRATION				
	B-21 (10-13.5)	B-22 (10-15)	B-22 (15-20)	B-23 (5-9)	B-26 (10-13)	B-27 (5-10)	B-28 (10-15)	Number	Mean Concentration (Population)	Standard Deviation	95th % Confidence	95th % UCL on mean
Sampling Date	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	9/16/2016	Analyzed				
Sample Depth Relative to October 1, 2016	10-13.5 Feet	10-15 Feet	15-20 Feet	5-9 Feet	10-13 Feet	5-10 Feet	10-15 Feet					
MADEP-EPH-04-1.1 (mg/Kg dry)												
C9-C18 ALIPHATICS	110	63	5.5	5.5				22	638			
C19-C36 ALIPHATICS	500	330	5.5	18				22	1211			
C11-C22 AROMATICS	1000	0.12	5.5	48				22	1796			
ACENAPHTHENE	0.275	0.12	0.055	0.32				22	0.314			
ACENAPHTHYLENE	0.275	0.12	0.055	0.055				22	0.238			
ANTHRACENE	0.275	0.28	0.055	0.32				22	1.22			
BENZO(A)ANTHRACENE	0.275	0.53	0.055	1.2				22	1.14			
BENZO(A)PYRENE	0.275	0.64	0.055	1.3				22	0.878			
BENZO(B)FLUORANTHENE	0.275	0.85	0.055	1.6				22	1.09			
BENZO(G,H,I)PERYLENE	0.275	0.12	0.055	0.82				22	0.509			
BENZO(K)FLUORANTHENE	0.275	0.12	0.055	0.57				22	0.522			
CHRYSENE	0.275	0.74	0.055	1.3				22	1.27			
DIBENZ(A,H)ANTHRACENE	0.275	0.12	0.055	0.19				22	0.283			
FLUORANTHENE	0.275	1.8	0.055	2.8				22	3.38			
FLUORENE	0.275	0.12	0.055	0.15				22	2.31			
INDENO(1,2,3-CD)PYRENE	0.275	0.12	0.055	0.79				22	0.573			
2-METHYLNAPHTHALENE	0.275	0.12	0.055	0.055				22	3.75			
NAPHTHALENE	0.275	0.12	0.055	0.18				22	1.75			
PHENANTHRENE	0.275	0.41	0.055	1.9				22	4.28			
PYRENE	0.275	1.7	0.055	2.7				22	2.50			
MADEP-VPH-04-1.1 (mg/Kg dry)												
C9-C10 AROMATICS								3	78.3			
BENZENE								3	0.270			
TOLUENE								3	0.140			
SW-846 6010C/D (mg/Kg dry) Metals Digestion												
BARIUM								0	Used 3-6 Foot Interval Exposure Point Concentration			
VANADIUM								3	28.3			
SW-846 7471B (mg/Kg dry) Metals Digestion												
MERCURY								0	Used 3-6 Foot Interval Exposure Point Concentration			
SW-846 8082A (mg/Kg dry)												
TOTAL PCBs	ND (0.11)							13	0.62	0.69274815	0.376575265	0.997
SW-846 8081B (mg/Kg dry)												
CHLORDANE								0	Used 3-6 Foot Interval Exposure Point Concentration			
DIELDRIN								0	Used 3-6 Foot Interval Exposure Point Concentration			
NOTES:									95th % UCL on mean = 95th % upper confidence limit on the mean			
									When none detected, one-half reported detection limit used to derive exposure point concentration.			

Table D-8
Calculation of Dioxin-Like PCB Congener Exposure Point Concentrations, as TCDD Equivalence
(East End Courtyard: October 2016)

Exposure Point	Units	PCB Exposure	Fraction as	TCDD-Like	TEF for	TCDD-Like PCB			
		Point	TCDD-Like	PCB	all dioxin-like	Exposure Point			
		Concentration	PCBs	Concentration	congeners*	Concentration			
			unitless		unitless				
East Part Courtyard: 0-3 Foot Interval	mg/kg	7.39	0.11	0.8129	3.00E-05	2.44E-05			
East Part Courtyard: 3-6 Foot Interval	mg/kg	9.80	0.11	1.078	3.00E-05	3.23E-05			
East Part Courtyard: 6-20 Foot Interval	mg/kg	0.997	0.11	0.10967	3.00E-05	3.29E-06			
Reference: USEPA's Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin & Dioxin-Like Compounds, (EPA/100/R 10/005/ December 2010)				* All detected TCDD-like PCB congeners had the same TEF value of 0.00003 (3.00E-05), which simplified the calculation of EPCs for dioxin-like PCBs.					
				EPC = Exposure Point Concentration					
TCDD = 2,3,7,8-Tetrachlorodibenzo-p-dioxin									
TEF = TCDD Toxicity Equivalence Factor									
TEQ = TCDD Toxic Equivalence (summation of products of congener concentration and TEF, for each congener <i>i</i>)									

Table D-9
Comparison of Risk Estimates to MCP Risk Limits
(East End of Courtyard: October 2016)

Receptor	Exposure Point	Soil Interval (feet)	ELCR	Cancer Risk Limit	Significant Risk of Harm?	HI	Non-Cancer Risk Limit	Significant Risk of Harm?
Construction / Utility Worker	East End Courtyard	0 - 3	4.6E-07	1.E-05	No	0.50	1	No
	East End Courtyard	3 - 6	5.8E-07	1.E-05	No	0.65	1	No
	East End Courtyard	6 - 20	1.4E-07	1.E-05	No	0.25	1	No
Resident	East End Courtyard	0 - 3	3.0E-06	1.E-05	No	0.62	1	No
	East End Courtyard	3 - 6	3.8E-06	1.E-05	No	0.82	1	No
	East End Courtyard	6 - 20	2.2E-06	1.E-05	No	0.29	1	No

ASSUMPTIONS:

NO SINGLE FAMILY RESIDENCE. NO GARDENING OF EDIBLE PRODUCE.

EXPOSURE TO SOILS OCCURS ONLY DURING A SINGLE SIX-MONTH CONSTRUCTION PROJECT, AFTER WHICH TIME THE SOILS ARE RETURNED TO EXCAVATION OR ARE TRANSPORTED OFF-SITE.

FOR 0-3 AND 3-6 FOOT INTERVAL SOILS, ASSUME CONTROLS ARE USED TO LIMIT FREQUENCY OF RESIDENTIAL EXPOSURE TO SOILS DURING CONSTRUCTION PROJECT.

PROTECTIVE COVER MUST REMAIN OVER SOILS EXCEPT DURING CONSTRUCTION OR UTILITY PROJECT, AFTER WHICH TIME THE PROTECTIVE COVER MUST BE RE-INSTALLED.